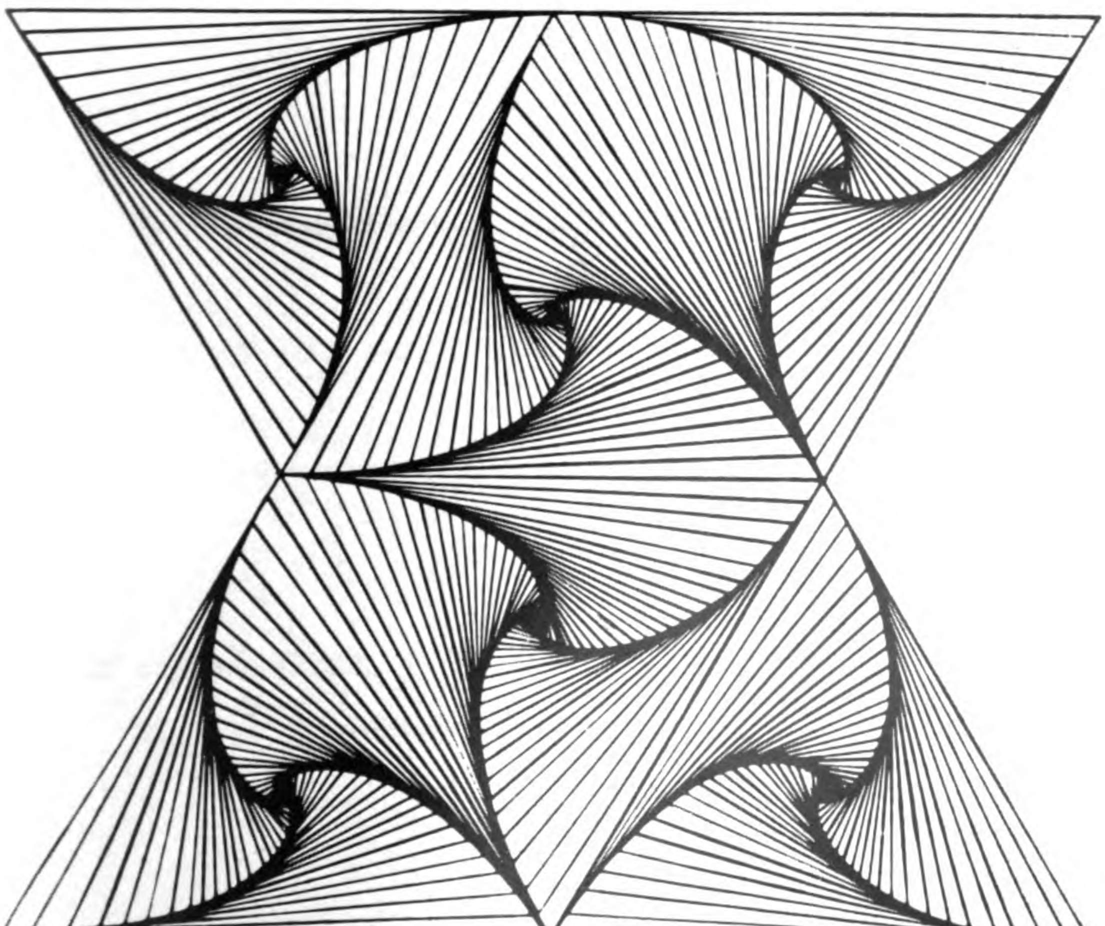
THEORIA to theory

Volume 5 First Quarter January 1971



THEORIA
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THEORIA to theory

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Editorial

In our last editorial we mentioned that the Pergamon Press would no longer be publishing us, and that discussions had been entered on with another publisher. We are now able to announce that Macmillan Journals will be publishing T. to T. starting with this number. We are taking steps towards forming a Readers' Association, and a form for membership of this will be circulated to you in the New Year. The association could, we hope, form a link through which some of its members may be able to be brought into collaboration with projects and with work in progress. The start with a new publisher coincides with our passing out of the stage in which a number of questions have been merely opened up, and coming to the stage where detailed work needs doing and the results fed into what is published in T. to T. We are compiling a list of people we are already in touch with who would be available for consultation on various specialized aspects.

The question, of course, arises as to whether the proposed Association could undertake larger scale activities, such as, for instance, an annual conference. But we do not want to propose artificial activities (that is, activities which are not really desired or needed by those for whom they are planned) or to compete on exactly the same terms with the many well run societies with cognate aims which exist already – and still less, of course with the Open University. Nor do we wish to ask readers to pay for services such as reporting on manuscripts, which we have been glad, and are still glad, to do for free. No, the research which could come out of this must be a collaboration between equals, not that of a body divided into academics and non-academics; and the sign that the time has come formally to start it will be that different and relevant research activities in different areas actually begin, informally and sporadically, to take place (this is already beginning to occur).

If any members of the readership have suggestions or criticisms or reports to offer on these lines, we shall be delighted to hear of them; and we wish to thank those who are already writing in. Compliments are not required; on the contrary, on such controversial issues as we are raising criticism and sceptical comment is exceedingly welcome, and genuinely new information is very highly prized.

* * *

Dowsing is one such topic. Our taking it up in a T. to T. context suggests we are regarding it as akin to the powers that are found in mystics and contemplatives. If it were put with material on astrology or racing tips, the suggestion would be different; with historical articles on primitive customs, different again, and so on.

The same argument becomes reinforced in the actual process of interviewing. One has to conduct it in one way rather than in other ways, and we conducted the interview with Colonel Merrylees that appears in this number knowing that the challenge of dowsing was capable of leading us directly into some of the questions that we had hitherto relegated to the future.

For example, take the sense in which paranormal powers are physical. In our discussion with Colonel Merrylees, he himself settled the question of whether or not we should take up this challenge by roundly asserting that dowsing is a mental phenomenon, and by the time we had begun to sort out what was meant by this in this context, battle was joined. Merrylees is certainly sure that no forces or fields known to physics are adequate to explain dowsing, and – as is pointed out in Christopher Clarke's notes about physical forces – this can be deduced immediately from the possibility of "map-dowsing" (dowsing at a distance using a map to convey the sense of the actual site).

If dowsing is due to no physical effect of any sort, however much generalized, then it is difficult to make sense of the other contentions of Merrylees. He asserts that he is able by dowsing to supply an answer to a question in the same way that parapsychological subjects may be able to answer the question "Is this Zener card an 0 or a + ?" However, no card guessing subject sees himself as dowsing for red cardboard, divining the extent of coloured patches on the other side of a piece of card. He sees the card as a sign of some sort. But this, which we may conveniently call the pure E.S.P. situation, does not at all fit the nature of the dowsing skill as we have it from Merrylees, for why these particular sorts of objects, and why this particular concern with land and what it covers?

One of our editorial functions will be that of steering clear of facile solutions (the pure E.S.P. and the directly physical explanations of dowsing being two such) as we develop our exploration of this and related phenomena. Unless the interview with Merrylees took the wrong line altogether, it seems that any theory of dowsing that is not to become facile will have to consider a change in our concept of physical objects. Some physical objects may incorporate the effects of the mental experiences of people who have had emotionally charged dealings with them, or in whose lives they have played a significant part. The colourful case for this would be haunting: an intellectually baffling, though less colourful, case bears on our present interest, and this is the possibility of conducting a dowsing survey from a map, where the suggestion is that the dowser looking at the map is reacting to the terrain itself and to the experiences of people in it.

As far as we can see, nothing that is less surprising than this will fit the bill. If we are wrong, we shall be glad to be challenged.

* * *

The cover design is by I. J. Good, who has written several times in T. to T. It first appeared in the Mathematical Gazette, 43, 34 (1959), and is reproduced by permission. It is based on "pursuit curves" drawn in six equilateral triangles. It is amusing to interpret this as the curve traced by three rabbits, each starting at a vertex of the triangle and always running straight towards the next rabbit. The straight lines are drawn from one rabbit to the next at successive instants of time, and give the direction of running at each instant.

Thoughts for Theoria : *Walter Roberts*

We don't know what it is to be, because we don't know what it would be, or not be, not to be.

This statement approximates to the confusion that we feel about our transient predicament in the universe.

In an instant we shall not even be able to say that we are as if we had never been.

Man's tantalising state is almost to grasp the certainty of knowing that he is, just when he knows with equal certainty that he is not.

The abolition of the verb "to be" might be socially inconvenient, but it would put on man the onus of re-thinking his position or lack of position in a void or non-void.

"Is" can indicate a casual identity, a marriage of convenience between terms, without any serious attempt at precision.

Our clumsy parts of speech qualify and modify equations of a terrifying vagueness.

The sparkling clarity which we ascribe to Greek or Sanskrit is not to be found in mathematics or metaphysics either.

We go gaily along, expressing ourselves, or giving people the illusion that we have selves to express.

The use of language depends on a rough agreement not to probe below a certain level of supposed significance.

To break this agreement is to arrive at nonsense states which can't be translated back into surface sense, but which have their own intricate patterning.

These nonsense states are as close as we are likely to get to the random bombardments of particles.

Fundamental art and science are indistinguishable in their commitment to dredging up pieces of paradoxical data.

Conversation and discussion provide a tentative medium in which what probably isn't can be partially examined.

When we put on any of the records labelled GOD, we have the sensation that some business of exceptional importance is to be transacted.

We look at ourselves in an unfamiliar mirror which claims to eliminate human distortions.

We tell each other hopefully that this is the level on which "to be" really is.

We define theology as the optics of all such mirrors, the acoustics of all such records, the economics of all such business.

By a curious twist of reason we bring back a particular technique at the point where we were about to generalise it away.

So the GOD-GAME becomes a highly specialised kind of nuclear methodology, or a privileged form of knitting.

A table of all techniques might show that it is the combination of two or more techniques that produces an advance in thought.

The computer introduces an uncharted element into all previous attempts at definition.

We have neared the point of being able to transfer the tangles of the human brain into a medium that is alien or neutral to it.

We fear to arrive at an independent valuation of the impassioned goings-on of our species, or of others.

The reality which the ancients invoked, which we dismissed, catches up with us at the corner drugstore.

The construction of an act of fate is the subject of drama, a continuum of the utmost logical strictness.

Our anxieties are brought to the boil, our fevers are inspected, by the physicians and surgeons of the theatre.

We glimpse occasionally by analogy the terms of some deal which has been done for us, or which we have done for ourselves.

"GOD" and "I" seem momentarily to be communicating material of a primary nature.

The instinct to set up an apparatus of evaluation is on a par with the child's wish to defend his sand-castle against the sea.

Later in life he comes to know the laws of hydraulics which govern the movement of waters, the laws of statics and dynamics that control the work of the spade.

Innumerable forlorn attempts to shape the material of the world according to the heart's desire challenge us again and again to repeat the experiment with ingenious variations.

Philosophising involves the total deployment of the apparatus of the human body in the meeting of profound environmental stresses.

We act out and dance out the possibilities of success and failure at every level, transparently disguising them according to topical codes.

We make our own liturgy of words and symbols out of the common pool left by all the sects and societies.

Philosophy re-emerges as the interpenetration of incongruities which clamorously demand explanation and classification.

So one says again, "Of course I am not! " – hardly hearing what it is that people supposed that one was, e.g. a philosopher.

Among scientists one is not a scientist, among writers one is not a writer, among gentlemen one is not a gentleman, etcetera.

One is thrown back on the wild guess that one might be a soul in relation to the cosmos which includes philosophers, scientists, writers and technocrats.

If such a cosmos is administered by GOD, it is likely to be better off than if it were carried on entirely at random.

The somewhat orderly activity of scientists, etc., is a sort of proof that everything is not falling headlong into an abyss.

Theology looks like the business of observing the different kinds of values that can be ascribed to the onrushing experiment of humanity.

"The queen of the sciences", the subject that contains all subjects, is a logical necessity, though she "reigns from the cross".

Supernatural legislation becomes a well-paid industry at some periods, and a scandalous crime at others.

The direct management of society by theological persons is a disaster that is unlikely to be repeated, but it continues in disguised form under secular dictatorships.

"God has less power than a policeman", said Berdyaev, but how is God to ensure that the policeman uses his power well?

The individual ceases to be, in proportion as technology achieves its well-advertised objectives.

It is wiser for him to assume that he is nothing, than that by the mercy of God he controls the destiny of millions.

The systematic annihilation of the ego is brilliantly executed by the process of decay and death in the average career.

We are left confronting for a brief moment the possibility that from the very beginning we got hold of the wrong end of the stick.

The church reappears with its tremendous platitudes just when they have been emptied of the last iota of significance.

The last rites punctiliously recapitulate the inspired nonsense that haunts man from cradle to grave.

The whole world of thought is not to be flung aside for the sake of a last-minute gamble on the improbable honesty of an alleged creation.

Yet, with Pascal, it is fitting that we surrender our narrow misconceptions for the vastness of "the Word made flesh".

Then indeed we know what it is to be, because we can no longer imagine any alternative to the fullness of being.

One thought for each year of life – now begins the fifth act, not yet lived in detail, with all its guidelines of sanctity and profanity.

The end-game has been sketched out only too well by the past misdemeanours and extravagances.

The rehabilitation of the creature is not necessarily the concern of the creator – e.g. expendable and disposable products.

The great cycles of reanimation sweep impartially through the degraded substance of dying matter.

The reaffirmation of one's positive powers is spoken from far beyond the region where one struggles for precarious survival.

Interrogation: The Art of Dowsing:

Kenneth W. Merrylees

(K. W. Merrylees is a retired Colonel in the Royal Engineers and a past president of the British Society of Dowsers)

Questioner

May I jump straight in and ask what your opinion is about the possibility of a physical sub-stratum for this power of water-divining or dowsing?

Merrylees

I should say practically none, because if there had been anything in the way of a physical explanation, surely modern science could have produced something – some sort of instrument – which would record what the dowser records. They haven't. That's absolutely definite.

Questioner

We had a description in the last number of *Theoria to Theory* of something that was claimed to do something analogous. This was a thing that was described in *The New Scientist* of September 24th and we got the chap who is involved, Dr. Peter Fenning, to come and tell us about it.* It was essentially a sensitive magnetometer trailed from an aeroplane and detecting changes in magnetic intensity due to changes in the terrain.

Merrylees

But trailing from an aeroplane is no more doing what a dowser can do than a geophysicist does with his resistance methods or his explosion method because it merely says there *could* be water; it does not say "in this area there is a line of flow", which is the only thing worth knowing. Do you agree with me there? The basis of my argument is always that the dowser must produce one thing, that is a document showing to the engineer who is going to drill the well, where the water is – a line on the ground, what its depth is, what its quantity is. Then it becomes an engineering proposition. If he doesn't know the quantity he doesn't know what size bore to put down. If he

*See *Theoria to Theory* IV iv, p. 63 (Ed.).

doesn't know the depth he doesn't know whether to arrange to drill 25 feet or 250 or 500 for that matter. It isn't practical politics until somebody can do that.

Questioner
Doesn't that make it sound more like a physical skill and less like an E.S.P. skill?

Merrylees
Not necessarily. Indeed, let me kill that at once by saying that I can sit in my room here and tell somebody who has a property, say, in Greece or Spain, if he's got any water under his land that's worth going for, and approximately where it is. Not a drilling diagram, mind you, but enough for it to be inspected for water.

Questioner
Now what helps do you need to be able to do that?

Merrylees
Often a very rough plan of the property. An ordinary ordnance one inch map is quite good enough to start, a six inch is better and a 25 inch is better still.

Questioner
You must have thought in your own mind what kind of connection there can be between the map and the terrain.

Merrylees
No. I look at it in a different way, I say that all the map is doing is focussing my mind on that particular area. You see, I'm visiting the place mentally, and the map is merely the link that I can use to go to that place mentally.

Questioner
Do you think it depends on there having been people there who made the map? Who had the place in their minds?

Merrylees
No. Because the man who made the map might have been dead fifty years ago.

Questioner
Oh yes he might. But then I wouldn't mind that. There was a mind, there was a person who established a connection. But after all a map is very unlike the physical terrain.

Merrylees
It has no contours on it and it has no indication of what the subsoil is. But it still works.

Questioner
Yes. I'm going with you, you see. I'm accepting your argument that you are in some way symbolizing the place, that the map is an adequate symbol.

Merrylees
Yes.

Questioner
The next question must therefore be, what makes it an adequate symbol? For example I could push it to an absurdity. If you just draw a wriggly line, that's not going to symbolize anything. I conjecture that perhaps somebody has got to establish a link in somebody's mind; there has got to be a bridge made between that terrain and that map.

Merrylees
Yes. But let me now go one further on that. When they start drilling the well (let's have it in Corfu because I've done it there) I take a sheet of paper, and I draw on it a small circle representing the well. Mind you, I sited the well. I've been there you see. Well now, if I draw my circle on a piece of paper and they've started drilling, I can day by day check how deep they've gone and when they stop drilling.

Questioner
And you're sitting in England?

Merrylees
I'm sitting in England. Yes. The only link is the piece of paper in front of me.

Questioner
And what does that feel like? How do you actually do that?

Merrylees
What I do is this. I have my indicator, which is only a little rubber pad, in my right hand, and in the other a pointer. I put the pointer on the well, and of course, having seen the site because I've sited the well, I can then visualize the area round and imagine what it looks like.

Questioner
You do a rough survey first?

Merrylees
I do a rough survey first.

Questioner
On a place which you have been to in the past?

Merrylees
Not necessarily at all.

Questioner
Now when you do this, do you look at the map and think what kind of a place it must be?

Merrylees
Yes, I do. I have recently done several of these map sitings (that is only approximately) for someone who lives just outside Bloemfontein. I marked my flows, and I said the water would be flowing in such and such a direction because of the way the streams joined up, and as far as I know my assertions were quite accurate. However, these are not drilling plans. To get *them* I would have to go there and check on each one to find out the best place with the farmer, or whoever it was, to get the correct site for whatever I was doing. Take a 25 inch map, a sheet of the ordinary English survey. If you draw an ordinary pencil line across that, it's probably about ten foot wide and that may be double the width of the movement of water that you're trying to find; therefore it's no good, you couldn't accurately mark it on the ground from that map, you could only do it approximately, so the dowser *must* go to the site and mark the centre of the flow accurately. Otherwise the thing isn't sense. I study the map as far as it gives me any information. If you gave me a map of part of Hyde Park, I would not think of siting a well there because I know what is underneath. It's several hundred foot of London clay, and unless you were going to go down into the chalk below, you haven't got a hope.

Questioner
You do the preliminary study of the maps and then you want to go and see the site . . .

Merrylees
You must see the site.

Questioner
You must see the site, and then you can come back and locate the actual place to drill while you're sitting here?

Merrylees
No. You locate the place on the ground, and mark it most carefully, to give, with the three pieces of information I mentioned, the line of the flow. If you are not specific drillers do peculiar things. I marked a well in Ibiza last year and the fellow who arranged the drilling unfortunately had to go away just before it started and the driller thought it would be much better for his drill to be 25 metres further away one side or the other and of course the well was a complete failure. That sort of thing happening is disastrous. That is why you *must* go and insist that a certain point for a line is used and nothing else. That's common sense isn't it?

Questioner
Oh, certainly. Accepting the astonishing gift of dowsing it is perfectly clear that you must do that.

Merrylees
You must make it into an engineering proposition before it is any good to anybody. It is no good running round the country saying "there is water here", because in England you can say that anywhere.

Questioner
Then, is the visit to the site mainly in aid of showing the engineers exactly where to bore, or do you need to do that for your own sake?

Merrylees
I do that for two reasons. The first one is that if a man has a property you don't want to give him a site which will be straight under his house. In fact, you want to discourage him from building his house over a flow, because it's often very unhealthy, and then, having arranged with him where on the line the well should be – fitting in with his garden and his house and so on – then you consider from the engineering point of view whether you can get the rig on to the site and so on. That's important, and makes it into an engineering job.

Questioner
But you can get your line purely by maps?

Merrylees
Roughly I can get the direction of the line on the map, enough to say "I don't want to go *there*, I want to go down *this* part of the estate". That works, I promise you it does. I've reduced my practice to the greatest simplicity that I can. You'll find people who run about the country with the most complicated bits of wire and this, that, and the other, and pendulums that have to be such and such a length and such and such a weight, and everything else. Right, if it helps them; I never say "don't be silly" I say "go ahead. If that works for you, use it". I don't want to have all that bother. I want to do it in the simplest possible way, because I believe that my mental processes will answer best to the simplest methods.

Questioner
Now what methods do you use? Do you use a hazel twig, or a twig of some sort?

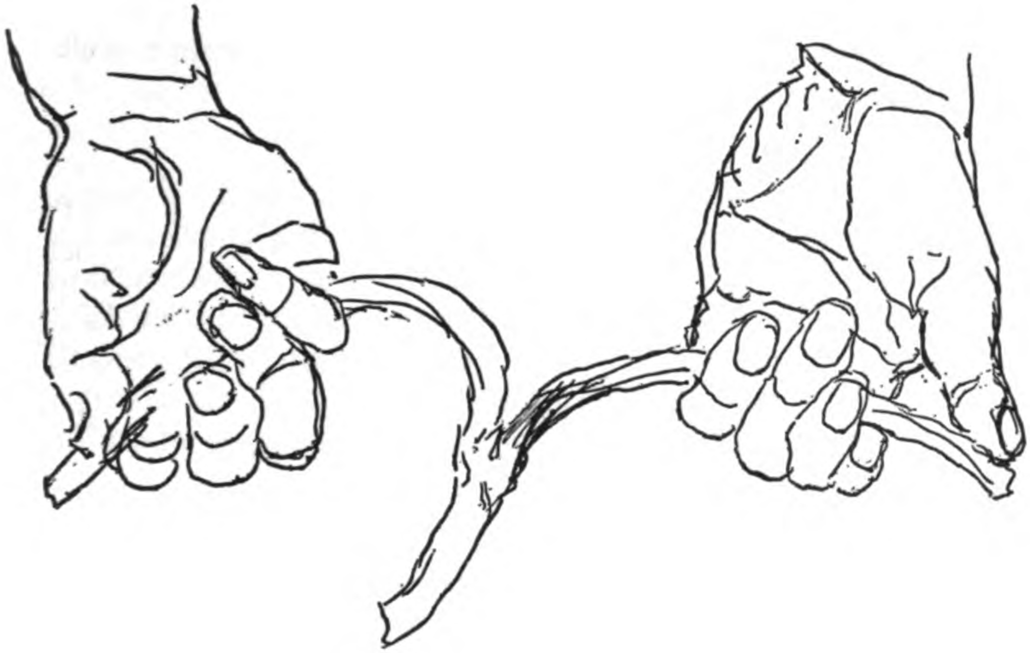
Merrylees
Well, this is a sad story. The normal thing is hazel twigs, but they dry up in a couple of days and are useless, so many of us went over to whalebone, but we can't get it now because women have stopped wearing corsets. I use two bits of nylon rod which are perfectly good, they're very cheap, they last for ever, they're easily seen if you drop them because they're white, and they're very light.

Questioner
And how do you hold them?

Merrylees
They are two pieces tied together at the end. I tie a bit of string round them. I buy them by the yard, actually, a single rod.

Questioner
Suppose you try without them?

Merrylees
Then, I've got no visible indication. You hold the thing in your hand like that, and ask yourself the question, "is there a gas pipe under this road, a cast iron pipe"? Then when you come over the pipe it will do a turn down. Why? Because your muscles turn it down. It's a reflex action and if you accept that as your form of indication it will work for you every time. But the dowser must ask the appro-



The diagram shows the dowser's hands, palm upwards, holding a Y-shaped twig bent so that the tension tries to straighten its arms. This tension requires that an unstable equilibrium be maintained: a very slight unconscious rotation of the dowser's hands about the axes defined by his arms causes the twig to dip sharply. Merrylees thinks that such a simple amplification device is typical of dowsing implements.

priate question in absolutely clear terms. In other words it's no good just wandering across the road and saying "Oh, I've got nothing there", because you haven't said *what* you're looking for. Ask yourself the question "Is what I'm looking for there? Is there water under this field? Is there a pipe under here?" Or in 1940 it was "Is there an unexploded bomb?"

Questioner
And you did do this, did you?

Merrylees
Quite successfully, where it didn't matter. Out in the fields I could do it every time where there was just a hole where the thing had gone in. I could say "It's turned and it's there, so many feet down", but in London where it had gone through a house, you couldn't go over it and I wasn't actually using maps for it then, and it was no good. We gave it up. But ironwork and things like that can always be found. Pipes, cables, everything.

Questioner
Let's go over this and you check me, as though it were a philosophical exercise. What is it you ask yourself?

Merrylees
Suppose you were looking for water. You're looking for a moving flow of water under the ground, so I first of all by a simple test find out which way to go; it tells me the nearest way to the next flow. That side, or that side, or what ever it is, and I start off in that direction, usually saying out loud "Is there any water where I'm going?", knowing it's flowing underground water I'm looking for, and then I walk until I get my pattern of indications of the water which I've learned. It's inbuilt now.

Questioner
And you know the pattern of indications for water, and you know the ones for something else?

Merrylees
Yes. Why *should* the same reaction apply to different things? Wouldn't you expect different things to react differently?

Questioner
I think the question is the other way round. Why should different things give different patterns if their effect is not physical?

Merrylees
They don't. They give the same pattern exactly but I am asking different questions.

Questioner
Is your reflex the same? Is it a kind of yes/no thing? You're saying "Is the water here?"

Merrylees
There is no "no" in my method of dowsing.

Questioner
Well, the "no" would be nothing happening. "Yes" would be a movement happening. Suppose you're saying " 'Is there old iron' or something out there?" would it be just the same movement?

Merrylees
It feels the same, exactly the same.

Questioner
The movement is a "yes" movement, whatever the substance. It isn't a slightly different kind of indication?

Merrylees
No. No. You see I don't believe that you can remember the difference between slight muscular pulls so to speak, from one day to the next, so I never use strength of pull for measurement in any way. Take an example, if you had a bucket, with a cover on it, half full of water here and I told you to lift it, and you came back tomorrow and I had put a pint in or taken a pint out, you couldn't tell the difference; you couldn't remember the difference.

Questioner
No. You'd have to do it in a more complicated way. So you mean that you don't use intensity of reaction as a measure of the quantity or quality of the substance?

Merrylees
You can't, I am sure.

Questioner
This is an absolutely key question, because if you could do this at all, it would negate what you have said before. If you could have a strength of reaction which depended on the existence of the thing, there would be some tangible force, and you are denying this because you are saying that it is a pure E.S.P. matter in the sense that you are answering a yes/no question. You see, if you are feeling for the conformity (or lack of conformity) of an assertion which you have made with some other elements of your own experience (such as your subsequent discovery of water) then that is different from anything like an estimate of strength or quality of reaction to some physical circumstance. The former case is what I earlier called "pure E.S.P.".

Merrylees
I can go further about the non-physical nature of the effects. In some places I have been looking for shallow streams and in some places I have been looking for deep streams, and if I'm looking for one, I cut out the other. I can miss it altogether. If a farmer says, "Look here I must have a shallow well here in the boulder clay, I want a sandbed with water in it, can you tell me if there is one on my property?" I'll look for that, but there might be a chalk one another

four hundred foot down, much bigger, which doesn't come at all into my consciousness. Nothing happens because I was looking for the other thing. That's why I feel the whole time that it is so much a mental process. The whole thing is yourself asking for information and getting an answer, and if you've got the sensitivity and the experience and the confidence you'll get the right answer most times. It's only when you think you know the answer beforehand that it's apt to go terribly wrong.

Questioner
Now it is true that you can only find running water?

Merrylees
No. It's the only one you look for. I can stand here and quite honestly say to you that there is water here but it's only because the boulder clay is wet all the way down, and below it is chalk which is definitely full of water, but if you dug a well you might get a couple of hundred gallons, three or four hundred gallons an hour from it. But if you went to half a dozen spots in the length of this village where water flows in the upper chalk, you might get five or six thousand, a good deal more out of the same well than you would get here. That's the difference. Running water is the only one worth looking for.

Questioner
So it is strictly incorrect to say diviners can only find running water.

Merrylees
However, it's the only thing they look for. Quantity as well as quality. If it has run through a fissure for millions of years there are not going to be any chemicals or anything usually in that fissure. It's much better water.

Questioner
What kind of physical conditions, if any, might dowsers find to be obstacles? Clear or thundery conditions, for instance?

Merrylees
I think the most likely upsetting factor is physical fatigue on your part. If I had been doing a lot in the morning, I always try not to do any in the afternoon.

Questioner
You find atmospheric conditions irrelevant?

Merrylees
Quite irrelevant. Yes.

Questioner
When we discussed this among ourselves we were disposing of various suggestions of a crude sort: that the effect could be due to emanations of one sort or another, fields or so on. Then atmospheric conditions, or a wind blowing, would matter enormously.

Merrylees
That is why I gave up using a pendulum, because you can't use it in the wind. That is why I never use the bent angle rods, you know, the things that stick out in front like that, that you hold parallel, because they can be blown by a wind like the one today which would make them quite useless, but my twig is held so firmly in its springy state that it isn't affected by wind.

Questioner
Also, if the process were in any way conveyed by physical fields or physical influences of the normal sort, then you'd expect to encounter the thing much more violently – I mean if the influences were in any sense electro-magnetic, it is very hard to believe that you wouldn't sometimes get a violent effect from pieces of electrical machinery. But you get nothing at all?

Merrylees
Nothing at all. Not unless you are looking for it. Take a cable; electricity may be flowing there or it may not, I don't think that it makes any difference.

Questioner
But you don't get interference?

Merrylees
No. Not at all. And you can do it from an aeroplane (You talked about an aeroplane just now). You can pick out anything you like from an aeroplane. You can find out when you are passing over rivers. It's too fast for underground flows because they are probably so frequent that you will probably get a continual flicker, but you can always check on a river which you can't do normally on the ground, except on its very edges, unless you are particularly looking for it.

Questioner
Are there any other physiological conditions which might affect you: whether you were sweating or not, for instance?

Merrylees
I don't think that that matters. I say fatigue is the only one that worries me. In a young man it shouldn't.

Questioner
I think it would. From my experiences with guessing cards, I used to get very tired, and that was a long time ago.

Merrylees
Well, I'm now 74 and as far as I know there is no difference between what I am doing now and what I was doing 35 years ago in India. As far as the operating of the thing goes, though, I know a lot more about it now.

Questioner
Would things like the amount of static electricity in your body at any given time be relevant?

Merrylees
No. I don't think that it is but I'll tell you one experiment that was done years ago in London. Dr. Monro who had a consulting room up in that curve at the top of Portland Place had an American over, a friend who had a very sensitive galvanometer. It really was. It was a great big machine, and he could read millionths of an ampere on it. A non-dowser – a person who wasn't a dowser at all – could, by holding two handles in a dowsing position, produce about ten units. But I and two or three others could produce 18 to 25 or 26 units on the same scale by taking up the dowsing position. In other words there was a difference in something . . .

Questioner
Well, did you try it in the dowsing situation? I mean did you put a penny under the carpet and then walk round the carpet to see what your count was?

Merrylees
No. That wasn't on, because of the type of instrument. You couldn't move about with it.

Questioner
Would you be prepared to do that if we set you up one?

Merrylees
Oh yes.

Questioner
There's this thing called the Faraday cage, isn't there, that insulates you from any electro-magnetic signals. Have dowsers tried working in that?

Merrylees
Oh yes. That's been tried. I think only with a sort of hen-house type of thing, because you can hop about in it.

Questioner
I suppose it would be difficult to make it completely sealed, though you could make yourself a suit of something like chicken-wire.

Merrylees
It wouldn't make any difference, I'm sure. I'm sure the difference is much more in the person himself. There was one Australian dowser who came over here and he was an excellent dowser in his own country—very well-known there. Now he had certain thoughts on it. We were working down near Warminster way (I was in the War Office then) and he always took every scrap of metal off himself, his money, penknife, everything else and put it on the ground, and the last thing he did before he did any dowsing was to take a little bottle of water and put it on top of his hat, without which he didn't feel he could do it properly. As a matter of fact, to let you into a secret, we filled his bottle with gin at lunch time—it worked pretty well after that.

Questioner
Gin is very bad because gin contains more than half water—

Merrylees
I know it does. Yes. But if he'd known it was gin it wouldn't have worked.

Questioner
You could have filled it with white spirit or something like that.

Merrylees
I know, we've tried it on other occasions, too. It's the same with rubber shoes. If he thinks he's got rubber shoes on, he thinks it won't work, and it doesn't.

Questioner
Now, various key questions I want to ask. First of all, you're a very literate kind of dowser, not to say a philosopher, and therefore I want to ask: do you think that what you're telling us would be the same as all dowsers would say if they understood the questions?

Merrylees
Yes. Of course I think people have their own ideas on it. If you went to Cecil Maby who wrote a book on it ("The Physics of the Dowsing Rod"), he would say the psychic thing is absolute nonsense, the whole thing is physical.

Questioner
From your observations of Maby you would say that his evidence doesn't really differ from yours?

Merrylees
He is just as pig-headed as I am but in entirely the opposite direction.

Questioner
You mean your practical field experience and your ways of setting about it would be similar but your interpretations would be different?

Merrylees
Yes. He used to use the ordinary twig. But I haven't seen him for years.

Questioner
Do you think most people could dowse if they tried?

Merrylees
In the last three or four years—this is not really confidential—I've been going to Chatham two or three times a year and testing classes of young officers and N.C.O.'s, intelligent young men from the age of 18 to 23 or 24 probably in classes of up to 30 at a time, and I tested over 330 of them by my simple method of first walking across where I said there was a flow, holding one end of the twig just like that, letting them hold the other end and touching their hand. Usually I can say straight off whether the person is going to do it or not. If I thought they could, I then said "now then, take both hands and hold it like this, and walk across here", and I watched the indication that they got. If I *still* thought it was all right I said "now go on, straight up the road there until you're stopped", and about

a hundred yards up the road was the next chalk fissure flow, and they would walk off and a Corporal would be watching them with a clip board with their names on it, and if he saw them get the indication that it was exactly where it ought to be, he stopped them and said "right, go back". And ten per cent of them could do that absolutely straight off. The next 36 per cent about were slightly sensitive. They could get a slight movement, but it wasn't a certain one and I put them in category 2, and the rest were quite, quite blank.

Questioner
So 36 per cent of all intelligent young men is at any rate a rough measure of some degree of capacity for dowsing?

Merrylees
Some degree, and ten per cent I put in the same category as a man with a good ear for music. He's not a musician because he's probably never even played, but he's got the ear, and they've got the sensitivity.

Questioner
Now, something has happened in that last description which worries me. You took your subalterns past a place where you knew there was water.

Merrylees
That was to see if they got the reaction with me. I was passing my muscular—my nerve-kick—through them to make their muscle do that.

Questioner
I would like to get you to imagine the following situation. Suppose that we were to set up an experiment and we were to agree that we would, quite arbitrarily, say there is a stream of water. We'd plot its course and we'd put in pegs so that people could discover them afterwards and this would be entirely arbitrary so far as it was possible to be so. We would make sure that there was no water there really. We would then ask you to detect that, and if you got it we would then tell you that you had got it right; after all, I suppose you don't always check if there really is water there when people tell you you have been successful. Now what would happen?

Merrylees
I would know straight away that it wasn't right, because if I were looking for water I would get a pattern of indications as I came up to the centre line and a pattern going off the other side, and without that I would know that it wasn't water.

Questioner
So a reaction does depend on the real presence of water?

Merrylees
Yes, because I would ask myself "is there any water here?" and I would get no pattern and therefore I would know that there was no water. If I came up to any part of that field and you said "is there any water in this field" and you had a line of sticking-up pegs all the way across. I would not be deceived because the first thing I would do would be to stand where I came on to the field, take my twig in my hand and turn round and if I didn't get an indication in the direction of those pegs I would know there was no water there. Even if they were all labelled WATER HERE, WATER HERE. I wouldn't go any further.

Questioner
So you mean you couldn't be responding to suggestion from us.

Merrylees
No. I wouldn't. No. The danger in all dowsing is when the dowser responds to suggestion of his own stupidity. He thinks "Oh well, there must be water here". Then he'll find it you see. That's auto-suggestion and that is a tremendous danger.

Questioner
There is a statement somewhere that a dowser couldn't use other dowsers' pegs.

Merrylees
That's exactly the same as the old man with his bottle of water. But there may be some people who just want their own.

Questioner
But this is incidental.

Merrylees
Yes. It's auto-suggestion, you see. A frightfully dangerous thing. It's the worst error that one can make.

Questioner
I don't doubt it. I mean that fits into a general psychic picture if you like. It would be very surprising if it weren't a great danger.

Merrylees
I don't know whether it is relevant or not but I don't think I am the least bit psychic in the normal sense. "Mediumistic" perhaps is a better word. I have no leanings and no capabilities that way. I don't think it is connected at all.

Questioner
Some of the things which people normally describe as telepathy you could do by dowsing, couldn't you? You could tell, say, even in the absurd case of my putting a playing card on the table, the answer to "Are there five hearts on the other side of that card?"

Merrylees
If I could do that I should have won the pools several times by now.

Questioner
The dowsing has to be for a substance of some sort does it? It can't be for information like "what's on the other side of this card?"

Merrylees
No. I've never tried that seriously. No.

Questioner
And has anybody, do you know?

Merrylees
I think some of them have. I think Blyth Prager probably has because he was much more interested in that side of it than in the purely dowsing side.

Questioner
Well, you see we have approached this from two ways now. There's the extremely pure E.S.P. hypothesis in which in no sense at all is there a physical effect. In the first part of the discussion, you rather came down on that E.S.P. side, but now I think you are not quite aware of the extent to which you've not exactly gone back on that, but you've brought forward situations which show that although there isn't an effect expressible in terms known to physics, nevertheless there must be a physical effect in a wide sense because you do demand that there should actually be water there.

Merrylees
Before you can find it. Yes.

Questioner
And you do demand also something else. You said that the actual presence of water has certain surrounding effects.

Merrylees
Oh yes. It has patterns. That is how I distinguish water flowing underground from water in a pipe, for instance.

Questioner
Although you said in the first part that it is merely a case of asking yourself the right question and then getting it answered. When I put to you various kinds of question you easily might ask in the traditional card guessing experiments, you were very sceptical as to whether you could do them.

Merrylees
Well, you come back immediately to my thing about how you must have (a) the sensitivity, (b) the experience, and (c) the confidence. It is absolutely impossible to do this type of thing without these three.

Questioner
Let's look at those separately. The confidence we'll write of straight away as being obviously necessary. This is why I didn't consider it worthwhile to go into your remarks about self delusion and all that sort of thing because they are very much a part of a wider picture. So we've got two left. Sensitivity and experience. Now let's deal with experience first. You said earlier—though I think possibly you didn't mean exactly that—that your experience would not be different for different types of material.

Merrylees
Wait a minute. I should have said—experience on *each* type of material is necessary before you get the necessary confidence. You can't—a musician with a good ear for music learns the piano for twenty years, he's a beautiful pianist— he can't pick up a violin and play it in just the same way.

Questioner
Are there some people who can naturally get mercury and some who might get gold, though one hears most about water dowsers?

Merrylees
No. I think it entirely depends on what they've learnt.

Questioner
But where does experience come in? You'd have to be the sort of chap who has gone in for looking for iron and things?

Merrylees
Yes. Exactly. I mean I've done various other things such as I mentioned, pipes and bombs and cables, because they came in my Sapper experience. I have on one or two occasions looked for lost people. I'll tell you about one because it's interesting. It came out in Blackwood's in '54 I think it was.* In '49 a friend of mine in the War Office rang me up – I was in London then, and said "We have just lost a Brigadier and his pilot in an Auster aircraft in Malaya. Can you help?" I said "Well, I don't know, but I'll try." So we went up to the Geographical Library and we got a map of Malaya and I searched it. I had no idea where they started from, I had no idea where they might be, and eventually I said "Village so-and-so" – I've forgotten the name now – anyway they said "That's in range of the aircraft's flight". They were lost in a very bad storm, and they wired out 7,000 miles to my village, and the R.A.F. did a search and found nothing; it was terrific jungle, hilly country. That was that. But then there were two sequels to it. About '54, five years after I did the search, an article came out written by the R.A.F. Officer, who had become a Group Captain who had done the search, and he related how, when these people were lost, three people came forward, and one, an officer out there, gave a pin point which was outside the range of the aircraft – miles outside so we could cross that out. The second one was a Malaccan woman, who stopped a British Officer in the streets of Malacca and said 'You've lost two officers", and gave my village, so again the search was on, and nothing was found. That was back in '49, and nothing was found till May '54, when they came across the wreckage of the aircraft, and of course the remains of the uniforms of the two men and not much else, which turned out to be within 14 miles of the village I had given, and that was the thickness of a pencil line on the map I was using, which of course was far too small scaled. Now, of course, had I known what I do now, I shouldn't have stopped at

* "The Third Pin Point", by A. G. D., Blackwood's Magazine. July–Dec. 1954, pp. 490–502. (Ed.)

giving the name of that village; I should have said "Send home by air the best air photographs for twenty miles round that village that you can get – the biggest scale and the best photographs". I believe I could have then marked that aircraft on the ground.

Questioner
I take it then that they had been killed on impact?

Merrylees
Absolutely yes. They had flown straight into a hill side. The only clue which I think was helpful was a letter that Brigadier Erskine had written to his mother in England some weeks before, I didn't read the letter or anything, but I had it there as the focussing point for my search and I asked the question "Is the writer of this letter alive, where is he?" You can read about that in Blackwood's, written by Dudgeon who did the search. And I had never met Erskine, I had never met his pilot, I didn't know Dudgeon, I didn't know anything. I had never been to Malaya.

Questioner
So that's an example of how you have to get experience of particular things, and obviously you haven't had much experience of looking for people. Now that must mean that when you start with something different there is a different feel to it.
A great deal of what you say ties up in a different area not water divining, with the very confused evidence which Lethbridge presents. You've read Lethbridge's stuff probably?

Merrylees
I have years ago. Not recently at all.

Questioner
He thinks there is some sort of effect produced by objects of a given sort. In particular he thinks that in some way an object can absorb the history of a period in which it's used or something from the personality of its owner. This is in a general way, consistent with your evidence. Obviously it is vitally important to get some sort of theory that could make sense of that correspondence, if it is correct.

Merrylees
Well, I'll tell you an interesting thing – to me, that is. I don't know any dowser who has ever found any buried treasure in spite of many people trying. And that's extraordinary because you'd think it

would be very dowsable, wouldn't you? Somebody who was definitely psychic and wrote books on the subject, said "You mustn't expect success, because if the particular thing was buried in very troubled times there will be built-up influence by the people who buried it to prevent anybody finding it."

Questioner
Lethbridge has accounts, doesn't he, of finding bits of jewellery, weapons and things? He was also a museum archaeologist.

Merrylees
Well, I think that would be quite possible. But it's quite different with something that has been very carefully hidden. In the case of the Knights Templars, who were destroyed by John and his friends and the French King, some of them must have buried some of the Temple treasure somewhere, but it's never been found. The King benefited very little from the Temple treasure. I accept that as a possibility that fits in with my mental theory, that one is touching something mentally, and I can believe that there are things that you wouldn't be allowed to touch mentally. I don't think anybody would ever make a great deal of money out of dowsing. My best wells, the ones which I am happiest about, have always been ones that I have done for free, for somebody who really needed them. It's maybe just a mental kink, like the old chap's bottle, but there's something in it.

But I think I know where King John's crown is, at this very moment, just by Sutton Bridge, and a lot of his stuff too, 18 feet down in the silt now, it will never be found. That treasure, you see, could have no guarding influence on it because it was just lost. All the wagons were just rolled over and washed down by the flood, so it wasn't buried deliberately by somebody wishing to hide it, or anything like that.

Questioner
I wonder if we could go back to this mental factor. Have you any theory as to how it might work?

Merrylees
Well you see, it's not a normal mental faculty at all, is it? I think, though, it is in this way: I think at some time in the human race's existence everybody had it to some extent, just as a horse or a dog in Australia finds its way to water or home, when it gets bushed.

I think that the human race had to have water to live and therefore probably had a natural faculty for finding it, I've always thought that. I think dear old Moses, didn't strike the rock, he said "You dig there", and found water. I think probably in those days it was a priestly gift, so to speak, and nobody else was allowed to use it, just as, I am sure, it was in medieval times. Of course the first recorded use of it in England was the German miners coming into Cornwall in Elizabethan times to look for tin. Nothing to do with water. But I don't think science will ever produce an instrument which will pick up – what shall we say – a plane of polarization, a short wave emanation, or anything of that nature which can be recorded on an instrument independently of any sensitive dowser and which will give the results which the dowser finds.

Questioner
So the dowser is himself a kind of instrument?

Merrylees
He is the instrument, but I regard his process as being an entirely mental one, I don't believe that when I walk over a stream that there is anything coming from that stream which is affecting my mind, my brain, or, from my brain, the motor nerve to my muscles.

Questioner
I don't think I know what you mean, since the stream has to be there.

Merrylees
Whatever I am looking for has to be there before it happens.

Questioner
Well I would regard the statement "the object I am looking for has to be there to get this indication", as equivalent to the statement, "there is an effect which I detect".

Merrylees
Yes, but what I am saying is, there is nothing physically coming from whatever I am looking for; I am picking up nothing other than by a mental process.

Questioner
The mental process you say is an unconscious one, because what you are aware of is the slight muscular reaction; you're not having a thought and then moving your muscles?

Merrylees
Oh no, but I must ask the question, or put it in my mind, as a focusing point for what I am going for.

Questioner
You could put it by saying you've got to learn how to use yourself as the instrument.

Merrylees
Exactly, yes.

Notes on Physical Concepts

Christopher Clarke

To understand the significance of dowsing, it should be seen in the context of what is already known of the laws of physics. Here I shall try to supply a slight indication of this context to the reader with little or no scientific background. The inherent dangers of over-simplification will be too apparent to need stressing further. I shall assume, following Merrylees, that the dowser's delicately poised twig merely acts as an indicator for the subconscious detection of the object by the dowser himself.

The conventional Newtonian picture analyses the world strictly in terms of motion and *forces*. The legendary Newtonian apple fell from its tree under the influence of the force of gravity, and after striking the earth was held in a state of rest by a balance between this gravity, acting uniformly throughout the whole apple, and the force of the reaction of the earth acting on the surface of the apple at its point of contact with the ground. The concepts of these two sorts of force, volume force and surface force through contact, permeated physical thinking. The force of contact seemed more comprehensible, perhaps because the force that unaided man was able to exert was of this kind, and it turned out that such forces were almost sufficient to explain many properties of matter.

The air, for example, can be analyzed into an aggregate of perfectly elastic molecules in random motion, the mechanics of their collisions being governed by surface forces. The propagation of a sound wave is described in terms of molecules bumping each other on in a mechanical way. Similarly, if extraneous molecules of a different type are released in a particular region, their outward diffusion is well described by this random jostling. In this way the senses of hearing and smell can be understood: in hearing the wave of mechanical molecular collisions finally excites nerve-endings in the ear; in smell the diffusing molecule wanders into the nose and excites nerves there. The transmission of these senses are so well understood that they can be ruled out as dowsing mechanisms. Smell would be affected by the wind, and buried metallic objects usually do not give off any molecules that could diffuse through many feet of earth. As to hearing, most objects are silent and would only be found by a bat-like echo-location system that could hardly have gone unnoticed in man. This suggests that even to explain dowsing in the presence of the object, setting aside map-dowsing, we must consider forces of the second type, the volume forces, which are not mediated by material body-to-body contact.

At a finer level of examination, looking at the interior structure of atoms and molecules, volume forces were seen to be fundamental, since the electrostatic force governs both the motion of electrons round the nucleus of each atom and also the forces between the outer electrons of one atom and another which give rise to both surface forces and chemical reactions. Some understanding of the volume forces was first reached by considering laboratory-scale effects. To picture the gravitational or the electric force due to an attracting body of some kind, the physicist associates each point of space near the body with its potentiality for producing a force on another small body, were it to be placed at that point. This system of potential forces around a body is called its *field*. Ironically, this concept reinstates at a pictorial level the idea of surface forces, with the field acting as a mediator in transmitting a force between two bodies with both of which it is in "contact".

At length-scales not smaller than the size of an atom (which is large by modern standards), the only significant types of forces or fields are the gravitational and the electromagnetic. The latter is brought into play by charged particles, and takes different forms according to the motion of the particles. There is a continuous gradation between the different forms, the extremes being very familiar: stationary charges give the electrostatic field of a rubbed fountain pen; those vibrating, as in a radio transmitting aerial or in the atoms of a hot body, give electromagnetic waves (radio waves or visible waves, respectively); while suitably spinning or steadily moving charges give the magnetic field of a permanent or electromagnet. An analogous classification can be produced for gravity by extending the mathematical apparatus. Because of this force's extreme weakness only the analogue of the electrostatic field has been detected conclusively, this being the form responsible for the gravitational pulls of astronomical bodies.

A field generated by one body can be modified by another, via a process of "secondary generation". The initial field disturbs the particles of the second body so that it too generates a field of its own which is added to the initial field. This is the mechanism whereby geological formations can modify low-frequency radio fields, as described in the last issue of this journal. Similarly, a static magnetic field is modified by moving water. On the other hand, both rocks and fired pots are often given a permanent magnetic field of their own by the earth's magnetism. In this way buried objects do induce conventional physical effects on the surface.

Great problems arise in trying to find biological detection mechanisms for these effects, which are exceedingly minute. One of the difficulties arises from so-called *noise* (in a metaphorical sense); any detector is inevitably buffeted by the thermal motion of surrounding molecules, which produces spurious "signals", and a similar interference can come from many other sources. Detecting the magnetic field of a small object biologically is analogous to hearing a whisper across a busy station at rush hour. If the whisper is repeated often enough, then sophisticated equipment can "average out" the noise and after listening for a long time detect the whisper. But the dowser makes his actual detection in a few seconds at most, thus demanding a mechanism that is fairly "quiet". This speed factor also rules out detection by comparatively rare events (a few every second) such as the emission of fast particles or high frequency electromagnetic radiation from the decay of atoms in the object; these events cannot transmit information of the quality the dowser seeks in the time available.

In view of these considerations it is vital to evaluate any proposed mechanism quantitatively, working out the expected magnitude of the effect to be detected, deciding whether a biological detector (taking into account limitations of size and temperature) can have sufficient sensitivity, evaluating the noise it has to contend with, and calculating the time required to gather the required information. In this purely conventional physical context it seems likely that it is not worth postulating any new, undiscovered field: for it to have remained undiscovered, as we see in more detail below, it must be much weaker than the electromagnetic field. If a conventional explanation, or at least a partial one, cannot be reached in terms of the electromagnetic field, there seems no hope of achieving one with an even weaker field.

By stretching all the parameters involved to their limits, it seems that some detection might just be possible, on theoretical grounds, close to the object using its static magnetic field in conjunction with co-operative electronic effects in the long-chain molecules of organic cells, which are still ill-understood and disputed. A static magnetic field-gradient would automatically be distinguished both from the uniform field of the earth and from the time-varying fields of current-carrying electric cables and other possible disturbing influences. One difficulty is the fact that the perturbation of the earth's field due to a steady flow of water in a straight fissure, although proportional to the rate of flow, is confined entirely below the surface of the earth; only the electric field is detectable above the surface. Even if such a mechanism could be established, one would still have to explain map-dowsing. Is it a different phenomenon altogether, as seems very unlikely from the way it is used by dowsers? If it is not, then, since all the fields that we have mentioned fall off with distance, an explanation in these terms is doomed from the outset.

At the most detailed level of sub-atomic phenomena the situation is not quite as clear-cut as we have suggested. The dichotomy between field and matter disappears and the term "field" takes on a new meaning. There is a great danger of being misleading here: concepts of sub-atomic phenomena cannot be mixed in discourse with concepts applicable to large phenomena without giving the appearance of paradox. Thus the following should be taken only as a hint, in mixed and inappropriate language, at what can only be expressed in a special formalism. In such a formalism all material particles are described by *fields* of their own, in a new sense of the word. A configuration of particles and fields (old sense) is now described as a *state* of all the fields involved, both the electromagnetic field and, say, the electron field. The classical picture of an electron moving uniformly is translated into a state of the electron field corresponding to "uniform motion", a state mathematically resembling a wave motion in this formalism. The dynamics of a system, the mechanism of its change in time, is represented by an *interaction* between two "overlapping" fields, or between a field and itself, which results in a transition being made from one state to another. All change is in terms of discontinuous transitions. Types of force are then replaced by types of interaction, the electromagnetic being one type (characterized as the only interaction that the electromagnetic field undergoes) and the gravitational presumably another, although it is too weak to appear on the subatomic scene. Only two others are known, called "the weak" and "the strong" (from their strengths relative to the electromagnetic interaction). Both are very short-range in effect, and are responsible for events inside the atomic nucleus.

This picture is linked to the observation that the electromagnetic field, like the electron field, is not continuous at a fine level, but is only available in discrete amounts called quanta. Individual electrons are the quanta of the electron field. A change of state corresponds to the addition or subtraction of quanta, roughly speaking. The concept of *energy* takes on a basic role, the total energy of a system being conserved through all its changes of state. For quanta of the electromagnetic field (called photons) the large-scale measure of energy is usually frequency; the higher the frequency, the larger the energy of the photons of which the state of the field is made up. For electrons, the quanta of the electron field, the large-scale measure of energy (E) is often the apparent mass m ($E = mc^2$). The apparent mass is always greater than the mass when at rest, m_0.

I have given this in some detail because some quantitative conclusions can now be drawn. The difficulty in producing new particles (quanta of an undiscovered field, as it were) is governed only by the intrinsic strength of the interaction which gives rise to them and to the minimum amount of energy (m_0c^2) that must be concentrated in order to produce one particle. In a quantum mechanical experiment the rule is that everything that can happen does happen, if you do it often enough. This limits the possibility of new particles (i.e. fields) playing a role in dowsing, being emitted from the atoms of the target and detected by the dowser. If the particles have escaped detection by conventional means, it will be either because they only undergo an interaction which is very weak, or because they have a very high rest-mass m_0 and so require the concentration of huge amounts of energy for their production. In either case their occurrence in nature will be very infrequent. So we are led to the same conclusion as before. Most of the exotic known particles can be eliminated on grounds of instability or infrequency of occurrence, so that if the homely electromagnetic quantum cannot explain dowsing, no other particle will help.

In explaining map-dowsing the basic problem is that all conventional physics is described in terms of a given, unquestioned structure of space and time. Any effect must become steadily weaker as it is spread out over greater and greater distances until it is swamped by other effects of the same type from nearer at hand.

Dowsing from a map, and hence perhaps all dowsing, is likely to remain incompatible with any physical explanation of the conventional type for this reason.

Prototypic Organisms III: The Blue-Green Algae

Patrick Echlin

The algae are the simplest members of the plant kingdom, and the blue-green algae are the simplest of the algae. Indeed, the blue-green algae resemble bacteria more closely than they do other forms of algae. By this token they occupy a distinctive niche in the evolutionary order of things. They provide insights into the evolution of bacteria and algae, and also, since they are among the most primitive living cells, into the beginnings of the cell itself.

Most of the blue-green algae are blue-green, but not all; they are found in a wide range of colours. Their name stems from the fact that the first species to be recognized as members of the group were blue-green. A few of the 2,000 species now known live as single cells of microscopic size. The cells of other species gather in colonies but still live essentially as individuals. Most species of blue-green algae, however, are filamentous: their cells are strung together in a hairlike structure. This is the form in which blue-green algae are most likely to be visible to the unaided eye, either as a mosslike growth on land or as a soft mass in water.

Whatever the form, the individual cells of blue-green algae are much alike. Each is surrounded by a gelatinous sheath. Inside the sheath is a thin membrane that encloses the cell's cytoplasm. The cell of a blue-green alga lacks a well-defined nucleus and the elaborate intracellular membranes and separate organelles of cells in advanced plants and animals. In the peripheral parts of the cytoplasm there are, however, complex lamellae, or thin sheets, that apparently form from the cell membrane.

Reproduction in most blue-green algae is a simple and asexual process. The cell merely divides. Some of the filamentous forms reproduce by a breaking of the filament, the two parts of which then grow by cell division. A few species of blue-green algae are able to reproduce by forming spores.

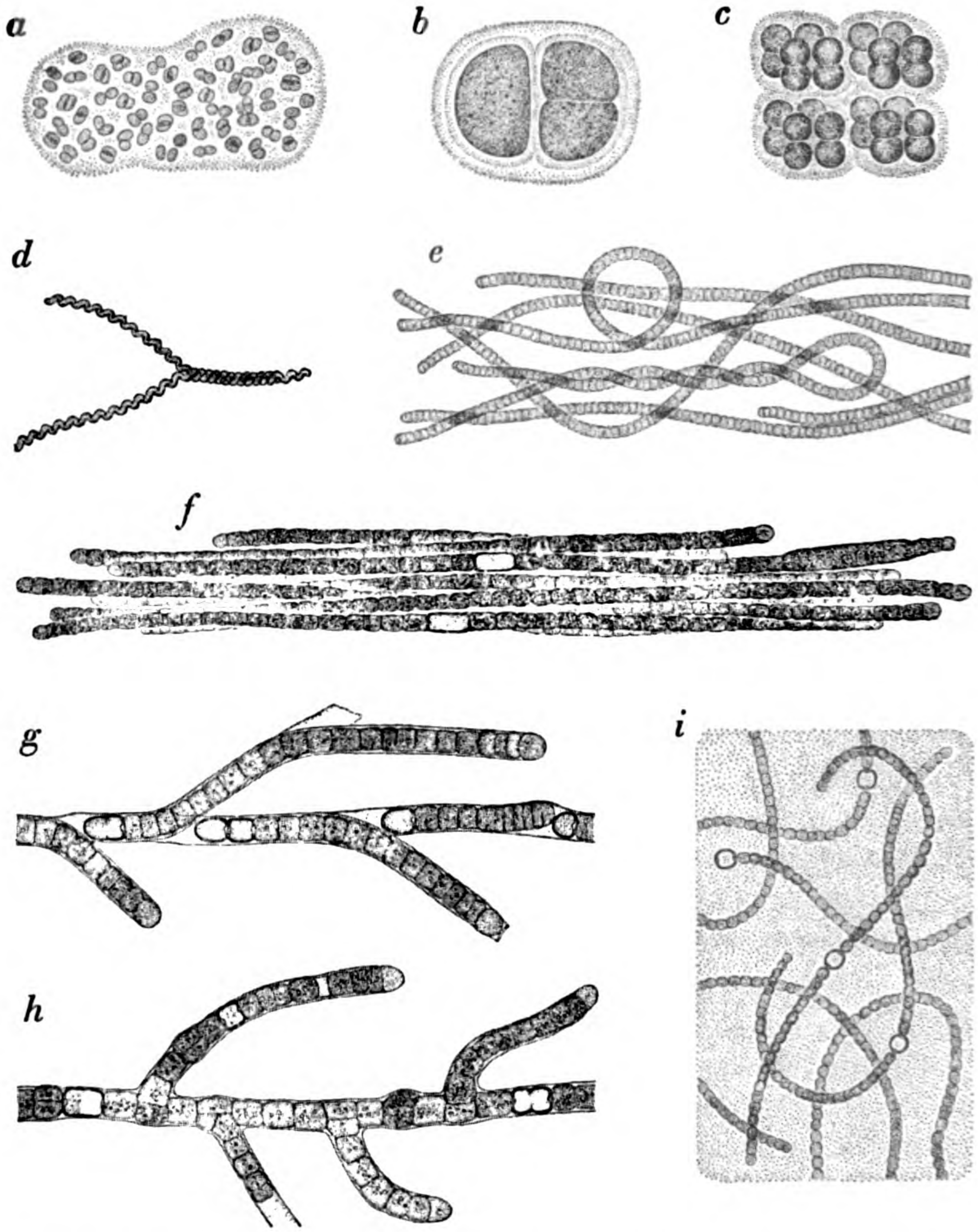
Like most other algae, the blue-greens manufacture their food by photosynthesis. They are distinctive, however, in that their photosynthetic pigments are distributed throughout the peripheral lamellae rather than in discrete bodies such as chloroplasts. A unique feature of certain filamentous species is the tendency to form heterocysts: large colorless cells at irregular intervals along a filament. The function of these cells is uncertain. According to various hypotheses they represent a vestigal reproductive cell, a store of food or a structure associated with either cell division or the formation of internal spores, or more recently, with nitrogen fixation.

The blue-green algae are widely distributed over land and water, often in environments where no other vegetation can exist. They live in water that is salt, brackish or fresh; in hot springs and cold springs, both pure and mineralized; in salt lakes; in moist soils and in symbiotic or parasitic association with other plants and animals. Most marine forms grow along the shore, fixed to the bottom in the narrow zone between the high and low tidemarks; a few float about as plankton. The largest number of species live in fresh water. Some can be found in fast-moving or turbulent waters, such as the water falling on rocks under a waterfall; others flourish in quiet waters—even in bodies of water that appear only temporarily.

On land in places of high humidity, such as gullies on the lower slopes of mountains, both tree trunks and rocks may be covered with gelatinous mats of many hues; the mats consist of single-celled blue-green algae. The filamentous algae form a feltlike growth over extensive land areas. Where high temperatures are combined with high humidity, as in the Tropics, the growth can be quite luxurious.

The wide variety of colours among blue-green algae has two main sources: the pigmentation of the gelatinous sheath and the pigmentation within the cell. The sheath, particularly in species that grow on land, is often deeply pigmented. Yellow and brown tints predominate, although shades of red and violet are also seen. The sheath colouration appears to be related to the environment—chiefly to the amount of sunlight received by the algae and to the acidity of their medium.

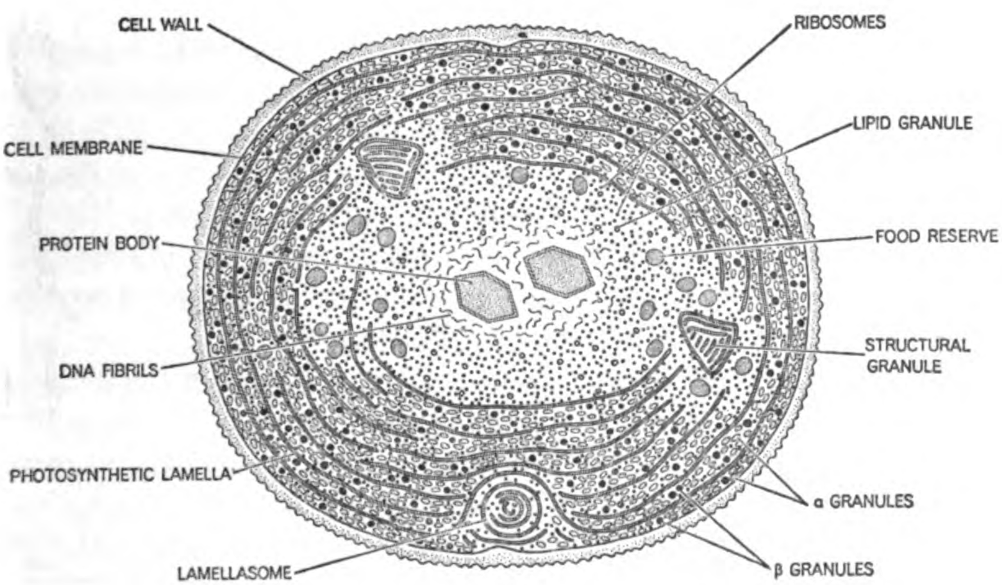
Within the cell are three pigments that are found in all plants capable of photosynthesis: chlorophyll, carotene and xanthophyll. In addition there are two pigments that are found only in this group of organisms: the blue pigment c-phycocyanin and the red pigment c-phycoerythrin. It is these two pigments that are principally responsible for the group's diverse colouration. The colours range from



TYPICAL SPECIMENS of blue-green algae include, at top, three of the unicellular and free-living variety: *a, Coccochloris* in a loosely formed colony; *b, Anacystis dimidiata* dividing; *c, Anacystis thermalis* in a compact colony. The remaining examples are of genera in which several cells exist together in a filament: *a, Spirulina,* with two intertwined filaments; *e, Oscillatoria; f, Aphanizomenon,* with two of the large, colorless cells called heterocysts; *g, Tolypothrix,* which is a genus with false branching; *h, Hapalosiphon,* which has true branching; *i, Nostoc* in a gelatinous mass. Each species is represented at an enlargement of about 280 diameters. (Reprinted by permission from 'Blue Green Algae' by Patrick Echlin. Copyright 1966 by Scientific American Inc. All rights reserved).

the red of the species *Oscillatoria cortiana* and *Phormidium persicinum* through the emerald green of the genus *Anacystis* to the near black of some algae that live on rocks. The colour of the algae is also dependent on the age and physiological state of the organism. Healthy cultures of *Anacystis montana* are a bright emerald green, whereas an old culture is a dirty yellow. There are even a few members of the blue-green group that are colourless; they live in such diverse habitats as the bottom of lakes, the intestines of animals and the human mouth.

Blue-green algae are often the first plants to colonize bare areas of rock and soil. A dramatic example of such colonization is provided by the island of Krakatoa in Indonesia, which was denuded of all visible plant life by its cataclysmic volcanic explosion of 1883. Filamentous blue-green algae were the first plants to appear on the pumice and volcanic ash; within a few years they had formed a dark green gelatinous growth. The layer of blue-green algae formed in such circumstances eventually becomes thick enough to provide



PRINCIPAL PARTS of a cell of *Anacystis montana*. This genus, like other blue-green algae, lacks the highly specialized structures such as mitochondria and chloroplasts that are found in the cells of higher living forms. The function of many algal structures, including the larger ones, is unknown. Not shown is a gelatinous outer sheath characteristic of the blue-green algae. (Reprinted by permission from 'Blue Green Algae' by Patrick Echlin. Copyright 1966 by Scientific American Inc. All rights reserved).

a soil rich in organic matter for the growth of higher plants. The algae further contribute to soil formation by acting to break down the surface of the rock.

The best-known example of symbiosis of blue-green algae with other organisms is provided by lichens, which are a combination of a fungus and a blue-green alga. Usually the lichen fungus can grow only if the appropriate alga is present. Lichens, like blue-green algae alone, play an important role in pioneering plant growth on bare rock. The relation between the fungus and the alga is not clearly understood. Presumably the fungus receives carbohydrates and perhaps nitrogen compounds from the alga, and the alga is able to survive in otherwise inhospitable environments because of the moist medium for growth provided by the fungus.

Several examples have come to light in which blue-green algae live parasitically within bacteria or other algae (including some blue-green species). I am currently investigating such an organism, *Glaucocystis nostochinearum*. This is a complex of two organisms: the host cell is a green alga that lacks the chloropyhll-containing chloroplasts, and within it are several filaments of a blue-green alga. Apparently the blue-green algae act as chloroplasts for the host cell.

The majority of blue-green algae are aerobic *photoautotrophs*: their life processes require only oxygen, light and inorganic substances. The process of photosynthesis uses the energy of light to build carbohydrates (and some fats) out of carbon dioxide in the air or the water. The process of respiration then uses oxygen to "burn" these products and supply the energy needed for the rest of the alga's activities. Unlike more advanced organisms, these algae need no substances that have been preformed by other organisms.

A few forms of blue-green algae, such as a species of *Oscillatoria* that is found in mud at the bottom of the Thames, are able to live anaerobically: i.e. their life processes do not require free oxygen. They obtain their energy from inorganic compounds such as hydrogen sulphide. Other species, notably some that live in the soil, can grow in the dark if they are supplied with suitable organic nutrients. Some forms are able to fix atmospheric nitrogen in soluble salts that can then be utilized by the alga itself.

A remarkable feature of blue-green algae in water is their ability to move even though they possess no recognizable locomotory parts. The filamentous forms can move fairly rapidly; the unicellular forms move much more slowly. All the blue-green algae exhibit a gliding movement parallel to the alga's long axis. The movement can be either forward or backward. Sometimes it is accompanied by rotation.

Several mechanisms have been put forward to explain these movements. One currently receiving attention is that the excretion of a mucilaginous substance propels the alga. Other proposed mechanisms involve osmosis, surface tension, the streaming of cytoplasm within the cell and the propagation of rhythmic waves of contraction through the cell. In connection with this last hypothesis a scalloped edge visible in electron micrographs of some species of blue-green algae may be significant. Such an edge could be associated with contractile movement.

From the evolutionary standpoint the algae in general are of interest because of the trends they reveal in the internal organization of the cell and the mechanism of cellular reproduction. The blue-green algae in particular, with their simple cell structure and asexual reproduction, appear to stand in close relation to the first organisms on earth. It is in this context that the similarities between the blue-green algae and the bacteria have intrigued a number of investigators.

Three features that set the blue-green algae and the bacteria apart from all other cellular organisms have been known for some time. These features are the absence of nuclei, the absence of specialized organelles and the absence of sexual reproduction. Citing the absence of certain features from two groups of organisms is, however, a rather negative way of establishing similarity between the groups. With the advances of electron microscopy in recent years it has become possible to examine the fine structure of blue-green algae and bacteria and so to find some positive similarities between them.

One such similarity is a fairly close resemblance between the cell wall of blue-green algae (not the gelatinous sheath) and the cell wall of bacteria. In both cases an important component of the cell wall belongs to the class of molecules known as mucopeptides. Another similarity is that in both blue-green algae and the photosynthetic bacteria (as in other photosynthetic organisms) the essential feature of the photosynthetic apparatus is a set of membranes enclosing a space. In the blue-green algae these are the lamellae; in the photosynthetic bacteria they are called the chromatophores.

These similarities and others argue strongly for isolating blue-green algae and bacteria in a group distinct from all other organisms.

I would also argue that the blue-green algae and the bacteria have probably descended from the same type of ancestral cell, although here I must rest my case more on speculation than on firm evidence. It is true that there are differences between the two types of organism. Blue-green algae are generally aerobic and photosynthetic and are more complex in form than the bacteria. The bacteria are either aerobic or anaerobic, but they are usually not photosynthetic; they require for their existence substances preformed by other organisms. In cases where bacteria are photosynthetic they differ fom blue-green algae in photosynthetic mechanism, particularly in the chemical nature of the pigments.

Still, the similarities are too marked to be overlooked. It is unlikely that so many kindred features would arise independently. This is the root of the argument for a common ancestral cell. The conspicuous differences between the blue-green algae and the bacteria presumably arose at later stages in their evolution.

It is generally agreed that Earth is approximately five billion years old, and that life originated somewhere between four and three and a half billion years ago. There is now fairly conclusive evidence that photosynthetic organisms existed on our planet more than three billion years ago. Some microfossils resembling blue green algae have been found in deposits over two billion years old, and recently a remarkable assemblage of organisms from the 1.9 billion year old Gunflint deposits on the shore of Lake Superior have been described. They resemble present-day bacteria and uni-cellular and filamentous blue-green algae, and appear morphologically more complex than microfossils from earlier deposits. There is good geochemical evidence that photosynthesis was occurring at the time these plants were fossilized.

One of the most remarkable of these organisms has a rather complicated structure called *Kakabekia umbellata*. Although it bears some slight resemblance to a group of modern stalked bacteria, nothing like *Kakabekia* had ever been seen before. Then, a couple of years ago, a *living* form of an organism resembling the Gunflint form was found in soil at the base of a wall of Harlech Castle which had been used as an improvised urinal. The soil contained high concentrations of ammoniacal compounds and subsequent experiments showed that this newly discovered microorganism, named *Kakabekia barghoorniana*, was able to live and grow in low concentrations of oxygen and high ammonia and methane—somewhat like the atmospheric conditions which is believed to have occurred two billion years ago.

The period between the Gunflint deposits until a billion years ago contains a number of deposits which in turn have unicells, spheres, filaments and colonial assemblages. Some of them clearly resemble bacteria and blue-green algae, but others are of more doubtful affinity. The geochemical evidence from these deposits shows that photosynthesis was probably occurring at that time, and the increasing association of these deposits with oxidized deposits of iron indicate that photosynthesis was becoming increasingly more significant.

A number of conclusions can be drawn from the study of microfossils from the pre-Cambrian period which ended half a billion years ago. Firstly, in the case of the bacteria, and of organisms resembling the blue-green algae, there appears to be a gradual progression from unicellular forms, through filamentous ones, to forms which may best be described as "complex filamentous". There is a gradual increase in morphological complexity.

Secondly, all the microfossils in the pre-Cambrian up to the Bitter Springs material appear to have been derived from "procaryotic" organisms. All living organisms can be divided simply into two main groups, the Procaryota and the Eucaryota. The Procaryota, which are comprised principally of the bacteria and blue-green algae, lack a discrete nucleus bounded by a membrane, and do not exhibit the types of cell division known as mitosis and meiosis. There are no known multicellular or distinctly differentiated procaryotic organisms and they are characterized by a lack of internal compartmentalization. The Eucaryota—which contain all other living organisms, from amoeba to Man—have the complex compartments of mitochondria and chloroplasts (where appropriate). They also have a discrete membrane-bound nucleus and variously exhibit mitosis and meiosis.

It has been generally assumed that procaryotic cells were likely to have been the first cell forms and the evidence from pre-Cambrian microfossils gives further support to this contention. Bacteria and blue-green algae constitute a small but important part of the flora of the present-day biosphere, and while the bacteria are generally widespread, the blue-green algae tend to occupy specialized, and quite frequently seemingly unfavourable, niches. Both groups appear to show little changes from their pre-Cambrian ancestors.

The first eucaryotic organisms probably appeared about 1.5 million years ago. As to how the Eucaryota may have evolved, is at the moment an open question. There is an increasing amount of evidence, however, which suggests that a process of "endosymbiosis" of small procaryotic cells with larger procaryotic cells may have been involved.

Finally, it is now clear that the first plants on our planet gave rise to the 20 per cent oxygen presently found in our atmosphere. It is generally agreed that our planet initially had an atmosphere that did not contain oxygen and which was in fact mildly reducing—a condition which would have favoured organisms like photosynthetic bacteria. Such organisms, although they are able to reduce carbon compounds to carbohydrate, do not use water as a hydrogen donor, and consequently do not give off oxygen in photosynthesis.

In fact, these microorganisms are strict anaerobes when photosynthesizing and they are inhibited by oxygen. The blue-green algae, although morphologically quite distinct from higher plants, share a common characteristic in that they evolve oxygen during photosynthesis, and it is thought that the blue-green algae were probably the first true plants. These algae were probably the only plants on our planet for approximately 1.5 to 2.0 million years, giving way to more complex eucaryotic cells which, in turn, evolved to the higher algae and eventually to land plants.

The appearance of the photosynthetic and oxygenic blue-green algae must have been an embarrassment to anaerobic organisms. It is likely that the oxygen was quickly reduced, either by reactions coupled enzymatically with the oxidation of reduced organic material, or by the oxidation of reduced iron compounds to oxides. Gradually, oxygen became a more tolerable part of the atmosphere. As well as acting as an absorbant for the intense ultra-violet flux which bathes our planet, this would permit aerobic respiration to occur, with its 20 fold increase in available energy.

Surprising as it may seem, it is possible to make some fairly accurate speculations concerning the habitat of these early plants. Initially the organisms must have been marine and living in at least 30 feet of water, which would prevent ultra-violet damage. As the oxygen concentration increased, the organisms would have inhabited shallow water, as in the Gunflint deposits, or shallow freshwater, as in deposits recently found in Greenland and Australia.

Considerable questions still remain. The problem of the origin of eucaryotic cells still remains unresolved. An even greater mystery is the apparent lateness in appearance in the geological record of multicellular plants and animals. The period of the pre-Cambrian procaryotic microflora lasted for about half the total biological history of the Earth, and it is only in the last 400-500 million years that there has been a great ouburst in diversity.

The answer to this may lie in three factors. In order that evolution could proceed to the level of multicellular and differentiated plant and animal organisms, cells had to become *eucaryotic*, *aerobic* and *terrestrial*. For there are, as far as I am aware, no anaerobic multicellular organisms, and no fully differentiated procaryotic cells present on this planet. The conditions for this to occur did not obtain until only about 500 million years ago.

Invisible Technology in the Countryside

Notes on an interview with Dr. F. Perring, Dr. J. M. Way, Dr. M. D. Hooper, and Dr. E. Pollard, of Monks Wood Experimental Station, Abbots Repton, Huntingdon, and on literature which they supplied. (Monks Wood is an Experimental Station of the Nature Conservancy which is particularly concerned with the relationship between man and the countryside).

On one occasion at a west-end theatre, the curtain rose on what should have been an elegant domestic interior, but unfortunately the backdrop had stuck halfway, revealing a tangle of ropes, pulleys, electrical gadgets and stage tools which are normally discreetly hidden by the scenery. It was a salutary shock, to realise how much we take the illusions of the stage for granted.

The same applies to many other aspects of technology, a word which we often associate with high-rise flats and clover-leaf road junctions, but which is seldom in our minds when we are bird-watching, sailing, or picnicking at the edge of a wood. We tend to assume that ponds, coppices or grass verges are "natural", which in our man-made English countryside is sheer nonsense; it is only that the man-made patterns have often had time to shake down. When, however, we see kestrels hovering over the landscaped verges of a motorway hunting for small mammals, or when we realise that we are sailing on a reservoir, we should begin to ask ourselves questions about the hidden technology which is so pleasantly producing an illusion of unspoiled Nature.

Dr. Way of Monks Wood speaks of this in relation to farming when he says: "Change is inevitable and changes in agriculture have been taking place ever since Man first started cultivating the land. We cannot prevent change, but we can and must direct it. How are the changes that are occurring so different from those that occurred before? This is probably a question of time, scale of operations, social demands and expanding technology. The change from muscle power, man and horses to tractor power has probably been responsible for a more complete revolution in the use of land than has occurred in so short a time at any period before. No longer can we have landscape and wildlife as a casual by-product of other land uses; we have to take actual positive steps to plan for them. And we have to be realistic about this by being positive rather than negative. Thus it is a negative thing to say to a farmer "Do not pull out your hedges", when every economic advantage to him points the other way. What we have to do is to work out economic field sizes in relation to the performance of farm machinery, as a result suggest to farmers which hedges ought to be sacrificed, and then encourage them by economic or any other means to conserve the remainder. For many people conservation means maintaining the status quo: not removing a tree or draining a pond to which they have become accustomed, not pulling down an old building or altering a landscape by building a road across it. But this is also a negative approach because the tree will grow old and die, the pond silt up, the old building crumble and the road, inevitably, must be built. Conservation should be a dynamic concept calling for imagination and knowledge, art and science, together with a willingness to pay. A realization that all things will change but that it is only how they change that matters" [1].

So the Monks Wood staff clearly accept the fact of change; their job within this shifting pattern is to protect existing habitats for wildlife where they can, and to look out for new ways of creating them within the new patterns. Particularly, as arable farming with its efficient machines and its hedgeless landscapes drives out wild plants and animals, they must be encouraged to go elsewhere. This involves a sophisticated technology, but in this field a rough guide to success is that the more the technology is obvious, the more it has failed in its object; the more we can forget it (as in the theatrical example) the better it is.

A good example of this principle is the Monks Wood work on road verges. In it we can see all the factors that go into a successful invisible technology. In the past, nature and a lengthsman with a hand-cutting tool managed the road verge between them, with the result that it merged imperceptibly into the working landscape that produced it. What they left, the farmer's grazing animals finished for them, when it was still safe for them to be on the roadside. Most of us would be staggered by the time scale involved in this merging process if what we admire is a diversified verge and hedgerow, which is also the best for conservation purposes. "In a 30-yard length of hedge each shrub species indicates 100 years in the life of that hedge.

[1] J. M. Way in *Agriculture*, July 1970.

A hedge with 5 different species of shrub will be about 500 years old, one with 10 species about 1,000 years old. Now hedges with 10 species in 30 yards are not uncommon, these hedges are our commonest archaeological remains of the Saxon period and should therefore be preserved for historical reasons if not for the conservation of plants" [2].

But if natural spreading takes so long, isn't it possible to introduce new species? The know-how for doing this is considerable, since it involves breaking into and replacing a whole eco-system. However, it can be done, just as we can decide to have rough or smooth grass, or to encourage or discourage birds and insects on the verge; this is the first mark of our "invisible technology", that choice replaces tradition, both in the creation and maintenance of the habitat.

"From a conservation point of view the aim is diversity of habitat in order to encourage the greatest variety of wild animals and plants. However, in any one place once a suitable form of management has been evolved, it will be important to try to apply the same management from year to year. Many plants and animals have quite strict requirements for a place to live, and a community that has been built up over a period of years under one form of management can quickly be destroyed by another. The communities of wild plants, of grass verges that exist now, and whose conservation is so important, have evolved under particular forms of management over many years. We can try to simulate these forms of management with the powerful machines and growth active chemicals that are now replacing hand labour, grazing and haymaking. We can also use these new tools to create different conditions and new communities of plants and animals. In addition we have the opportunity on the new verges to manage them in such a way that they contribute something real to the countryside" [3].

The first choices are not always happy. We have all seen whole verges treated with herbicide, and the resultant dead plants and grass are depressing to the eye and disastrous to the cause of conservation. Or it may be decided, for financial reasons, to do nothing to manage the verge and in one year the whole complex gets out of hand from the point of view of road safety, injurious weeds, field and road drainage and horse and pedestrian use [4]. Meanwhile, experiments

[2] *Hedges and Hedgerow Trees*, Monks Wood Symposium No. 4, 1968, p. 52.
[3] J. M. Way in *Road Verges*. A symposium, 1969. Monks Wood Experimental Station (Nature Conservatory), p. 61.
[4] *Road Verges*, p. 24.

are showing more satisfactory ways of management, using all the new knowledge available; for example, cutting different widths of the verge at times which allow for nesting and seeding in the rear portions, but ensure safety and visibility by keeping the front swathe short; using chemicals such as maleic hydrazide for growth retarding and cutting with mechanical flail mowers on established verges and lighter machines on newer ones [5]. The net result of these highly technological procedures is that the verge continues to merge "naturally" into the countryside, and that the ecological balance is not destroyed, so that the verge and hedgerow (if any) become one of the last remaining refuges for wild plants, and the insects, birds and animals that need them for food and shelter. This is not only aesthetically important, but it is vital to establish genetic banks for repopulating the countryside if man-made hybrids succumb to disease [6], or if a change in arable farming brings a chance for re-establishment of wild fauna and flora in their old haunts.

A second condition, therefore, for "invisible technology" is that there should be complete national and regional records of plants and animals, readily available for reference in any locality, so that particular stretches may be managed with full knowledge of their potential value; and through this activity at Monks Wood, Dr. Perring, who directs the Biological Records Centre there, is establishing a complete picture [7]. Moreover, out of the 9 major classes of habitat in lowland Britain, five can occur together on a verge backed by a hedge and ditch (scrub, tall herb, grass, open and aquatic habitats) and three others occur in likely situations (forest, reed and agricultural), and at present "verges are the richest single habitat for wild plant species in the country" [8]. A substantial number of very rare plants are represented in verges, and for eight of these the verge is the main and occasionally the only habitat. One such (*Bupleurum falcatum*, "Hare's ear"), which grew only in one Essex roadside, became extinct after roadworks in 1962.

These possibilities would apply to established roads of all periods, but the richness and diversity of native flora in earthworks which originally caused great disturbance turned the eyes of botanists in the direction of the new motorways as potential new habitats. For instance, in Cambridgeshire, "the pre-Saxon Devil's and Fleam

[5] Ibid., pp. 47, 52.
[6] *The New Scientist*, Oct 22, 1970, p. 71.
[7] F. H. Perring in *Road Verges*, p. 12.
[8] Ibid., pp. 10, 11.

Dykes are the most important sites for chalk grassland plants in the county" [9].

The greatest earthworks built in Britain since the Early Ice Age are the railway embankments and cuttings, and stretches of these are becoming nature reserves with rich and varied plant and animal life, including the badger. The Monks Wood staff are therefore greatly concerned with methods of establishing and maintaining motorway verges, where, with great disturbance, an entirely new landscape is being created, which could and should be married to the old. No longer can this result depend on time and the lengthsman, so once more "invisible technology" is in demand. The actual construction of the road is a fascinating example of the process; "ideally, no part of the road except the carriageway itself and the structures would register to the driver as something man-made . . . If the treatment is crude, to the driver the apparent width of the road will be the road surface plus the verge and fences—all the obviously 'constructed' road. Add unsympathetic planting, and his attention will be held within this corridor, so that concentration on the foreground view will soon lead to boredom and danger. At its best the road will appear to stop at the back of the hard shoulder and the rest will be part of the countryside beyond. The road is then just a narrow ribbon slipping smoothly through the countryside and the driver's view is as wide as the horizon" [10]. The devices employed to achieve this "inevitability" are manifold, first of all the impressive design and contouring of the earthworks, to give gentle gradients of a line fitting the topography. These earthworks have to be stabilized from erosion and slips on to the carriageway by a quick growth of grass, which is now achieved by "hydroseeding", or application of seed mixture in a jet of water, followed by a layer of tacky straw or glass fibre [11]. The grass mixture should be native and its ultimate height calculated. Next comes verge technology, for verge functions are very complex, including water drainage, pedestrian passage, prevention of overhang and obstruction of visibility, particularly at bends and junctions, weed control, and amenity [12]. Planting requirements are equally varied, for they ought to be native plants and grasses, they must screen unattractive features and construction scars, frame views, provide contrast and

[9] Ibid., p. 13.
[10] Ibid., pp. 3, 4.
[11] Ibid., p. 46.
[12] Ibid., p. 39.

prevent boredom, and tone down noise; for safety they must prevent dazzle from headlamps or the rising and setting sun, provide snow and wind breaks, indicate summits and bends from a distance, form barriers on embankments and in central reservations, and stabilize cuttings by root action. While providing for all this, the landscaper must avoid obstruction of sight lines, skid hazards from wet leaves, ice and falling branches, damage to the surface or the drainage by roots (e.g. poplars) and interference with overhead or underground services [13].

At last, with the road established, the wildlife conservationist has his chance, if he can establish a working partnership with the Ministry of Transport, for here is abundance of land (7,500 acres on the motorways alone) [14], which can become entirely new habitats of native and localized eco-systems of wild plants and animals. The verge survey, undertaken by Monks Wood staff and University botanical students with the Ministry's co-operation in 1970, has already been publicized by its author, Dr. Way, in *THE NEW SCIENTIST* [15], and he maintains that motorway verges, if they are intelligently planted and given stable management over a long period have outstanding potential value for conserving wildlife in England. Other favourable factors are that the entire motorway system is under one management, that there is no digging or dumping on established verges, and that the public is excluded.

It is obvious that a further feature of the "invisible technology" of a well managed countryside is very wide co-operation at national and local level; and this is a further mark of the Monks Wood teamwork. Already they have held a number of symposia on conservation issues, such as one on Hedges and Hedgerows, and one on Road Verges from which we have quoted, in an attempt to draw in everybody whose work affects the land and the wildlife on it. Farmers, foresters, road engineers, landscape architects, amenity societies, county surveyors and their staffs, as well as every kind of botanical and agricultural research worker, have been brought into the discussion, for of course it is very largely on local initiative, including the county Naturalists' Trusts, that responsibility for ongoing conservation rests. That the ordinary householder too can be a party to "invisible technology" is recognised by a Monks Wood

[13] Ibid., pp. 43, 44.
[14] J. M. Way, "Roads and the conservation of wild life", *Journal of the Institution of Highway Engineers*, Vol. 17, 7, July 1970.
[15] *The New Scientist*, September 10, 1970.

pamphlet on *Conservation in the Garden*. Ordinary formal town gardens, if they are not too weedless, exotic and generally "garden-proud", can be valuable sanctuaries for bird and insect life, and garden ponds can be a haven for the vanishing frog. Less happily foxes, robbed of their rabbit diet by myxomatosis, are forced into the centre as well as the outer suburbs of cities, and are learning to make their living off dustbins. Churchyards, too, if trees and long grass are allowed, can encourage the living as well as sheltering the dead; water habitats are a subject to themselves, which merit separate and detailed treatment. Enough perhaps has been said to make us respond more warmly and perceptively to the vast invisible technological network which is daily cast in all directions to help us to a greater enjoyment of "unspoiled Nature".

Mao and the Dark Aspects*

Joseph Needham

As one looks around the world at the present time one has a feeling that the ice is breaking up – the ice of fixed ideas and political dogmas both on the left and on the right. Young people of today, all the world over, are rejecting the traditions of capitalist respectability, the dogmas of marxist socialism, the constraints and compartments of the traditional religions and the confessions of the churches and schools within them; they are testing all things (including the false escapes of drugs and eccentricities). Will they hold fast to that which is good when they find it? I believe they will, and I suspect that a considerable part of this present health-giving unrest is due to the influence of China on the rest of the world. By a strange reverse action, the Western world, intent upon a wicked and cruel domination of an East Asian people, has brought upon itself not only the loathing of its own youth, but also a profoundly unsettling influence from a greater East Asian people who have taken the way towards a new form of society. *Fan chê Tao chih tung*, "Returning is the characteristic movement of the Tao" – Lao Tzu is proved right once again. For Chinese Marxism is truly Marxism with a difference, the difference necessarily brought about by the crossing of the phase boundary between Christian civilization and Chinese civilization. Now it reacts upon the Western world as something deeply inspiring, manifold though the interpretations of it are among the young in different cultures Eastern and Western. It is not exactly anarchist in tendency nor yet to be summed up as Confucianism and Christianity put into practice; we do not yet know quite what it is.

Today a rapidly increasing number of people subscribe to "the doctrine that man is the highest being for man; and to the categorical imperative to overthrow all conditions in which man is a humiliated, enslaved, despised and rejected being". These were Marx's words in the critique of Hegel. In our own lifetime we have seen enormous steps forward in social evolution, and among them by far the most important probably in the eyes of future historians has been

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the Chinese revolution, now 21 years old. Two decades are almost one generation, and in China today probably 250 million young people have no direct knowledge of what their country was like before 1949. Yet for those of us who vividly remember life in wartime China under the Kuomintang a generation ago seems only like yesterday. Those were the days when in one year (1943) a million people starved to death in two quite separate famines, one in Central and one in South China, and when peasant boys in their thousands were seized as conscripts and marched for hundreds of miles to their death in the North-West. I myself shall never forget the poverty of the Chinese people that I saw during those years, a destitution completely mediaeval. I can remember too the misery of the young soldiers blinded by trachoma and dying of dysentery and many other diseases, which the Army Medical Corps, to which I was an Adviser, had not the means to overcome.

On the 1st October, 1949, Chairman Mao Tsê-Tung, standing above the Gate of Heavenly Peace in Peking and announcing that "the Chinese people have stood up", proclaimed the new People's Republic. This was a phrase of special meaning for us because we remember the song of the Levellers in the English revolution of the 17th century, "Diggers All Stand Up Now!" Mao's words signified nothing more nor less than the final overthrow of an out-of-date social and political system which had become effete, corrupt and inhuman. Traditional Chinese society, already in decline at the beginning of the 19th century, had been shaken to its foundations by the impact of aggressive Western capitalism and changed by it into what has been called a semi-feudal, semi-colonial system. In Kuomintang China it was the worst features of the old society which tended to survive, and that party grafted on them what was essentially a fascist system with the single saving grace of relative inefficiency. Despite its strong Western backing, this system, as I know directly from personal experience, had no popular support, and when the country people and the industrial workers, whom Mao had found the way to organise in the Chinese Red Army, first defended themselves against its attacks and then moved to overthrow it completely, it collapsed like a pack of cards.

Thus the way was cleared for the building of a new society. In a single decade the mass of the people attained, broadly speaking, freedom from want and also freedom from worrying about their future. Of course there was a small minority of the discontented, those whose vested interests had been hit, and some of these fled away to Formosa or the Western world, but as time went on acceptance of the Kungchhantang's leadership became ever more willing, for Chairman Mao is, to the vast majority of Chinese, a veritable Moses who has brought them out of the Egyptian bondage of prostrate colonialised society into a land not only promised but palpably real.

Of course there have been setbacks, and difficult lessons to be learnt. During the "hard years" of natural calamity and the withdrawal of Soviet help (1959-61), and the years of recovery (1962-63), the danger of a retrogression from socialism and socialist ideas arose, and incipient capitalist tendencies showed themselves both in town and countryside. It became clear that socialist institutions alone could not guarantee socialism. There was a battle still to be won in the hearts of the people, and each generation would need to be trained in altruistic socialist morality. Hence the socialist education movement launched in the countryside in 1963. In 1967 in one of his speeches, Mao Tsê-Tung spoke as follows: "In the past we waged struggles in rural areas, in factories, and in the cultural field, and we carried out the socialist education movement, but all this failed to solve the problem because we did not find a form, a method, to arouse the broad masses to expose our dark aspects openly in an all-round way from below." What a memorable phrase ths was, "our dark aspects"; he meant of course the almost unconscious tendency of any group of people in commanding positions to do better for themselves than the majority, to appropriate goods in short supply, to order people about, to be thick-skinned concerning the needs and hardships of individuals, in fact to commit all the bureaucratic sins. But a way out was found in the cultural revolution, that tremendous educational upheaval out of which a new China is again emerging.

Over here there are many people who have ambiguous feelings about China. There is much interest, widespread suspicion and misunderstanding, and a total lack of any deep comprehension. If I say anything I can claim to speak on the basis of three summers spent there since the Revolution. If I were to be asked to summarise the meaning of the Chinese revolution in two sentences I should say, first, that it was an irrevocable decision of the Chinese people not to follow the way of capitalism through the whole weary path of the "dark Satanic mills" but to move straight from their age-old bureaucratic society to modern scientific socialism. Secondly I should say that with complete clarity and determination the Chinese people are working towards a truly classless society, knowing this will take a revolution of hearts and minds not easily to be won, and needing, perhaps, perpetual renovation. But *hsin min* ("renewing the people") was an ancient Confucian watchword, and now it is being practised as never before.

A phrase from Gerrard Winstanley often comes into my mind; in one of those Civil War pamphlets, he said: "You jeer at the name Leveller, but I tell you that Jesus Christ is the head Leveller". Of course you needn't adopt the name of Christian to carry out what the Gospel says about the love of one's neighbour, you can vigorously repudiate it, as the vast majority of Chinese people would do today, yet nevertheless you may be putting it into practice. I could use Winstanley's phrase and say: "You laugh at the Little Red Book, but I tell you it is the inspiration of one fifth, maybe one quarter, of the present population of the world". You can call it, if you insist, a new religion, and indeed it does draw especially from Christianity and Confucianism, and unquestionably Chairman Mao is a numinous figure, because in China ethics have always been numinous. Only take one of the present Chinese slogans, *chan ssu, tou hsiu* "renounce self-seeking; repudiate privilege'—is this not putting in practice the *agapē tou plēsiou* of the gospels? A million acts of heroism and mercy in the service of the people are being celebrated today in Chinese culture.

If I often feel inclined to believe that Chinese socialism may have a key which might unlock many doors into the future for the whole world I am not without strong reasons for it. I should like to put before you half a dozen of these. First of all, what is it that is wrong about affluence? There is an alarming paradox confronting us today of disillusionment, cults of senseless violence, corruption in the arts and theatre, a mad confusion between good sex and evil sadism, an urge to contract out of all society, including the flight into drug-taking, intellectual poverty and alienation in the midst of plenty. The United States, I suppose, has the highest standard of life in the world, and yet it is the unhappiest of countries, from which many are already seeking to flee. To a lesser extent Europe is struck with the same blight. What has gone wrong? After all, that the standard of life should rise, has always been one of the greatest aims of the socialist movement everywhere, and one instinctively supported by all those who feel for their fellow-men. But it seems that abundance, unless controlled by ethics, brings deep evil with it; more washing machines, more television sets, more private cars, more large flats for small families, may mean less pioneering community services, less devotion to duty, less attachment to the pleasures of life that can be enjoyed without expensive equipment. How to overcome "hire-purchase debauchery" and the selfish passion for the acquisition of things? This is where the Chinese tradition comes in, because for the past 2000 years the Confucian system of ethics, perhaps the greatest the world has ever seen, never depended upon, and indeed rejected, supernational sanctions. It sprang, in fact, from a doctrine of the nature of man. To act nobly *is* his nature, requiring only the right training. Closely connected with this is the fact, not often sufficiently appreciated in the West, that the idea of original sin was in China heretical—in so far as anything could be called heretical in that culture. In China Pelagius was orthodox, Augustine mistaken. This is a profoundly important point, because the idea of original sin as it has been expounded by many theologians, has for centuries been a positive barrier to the optimistic estimate required for the construction of socialism. Of course it is obvious that we have, built into ourselves, certain traces of our animal ancestry in evolution, which give sufficient colour to the doctrine of original sin to permit of its acceptance when stated in minimal form. But at the present time we are witnessing a recrudescence of the crassest "biologism" in that movement of thought which I suppose is most typically exemplified in Desmond Morris' "The Naked Ape". As John Lewis has pointed out, this is only original sin in another form, and a form remarkably like the propaganda of the Nazis before the second world war. The Chinese will have none of this. It did not take modern evolution theory to teach the sage of Shantung that man is unique among living beings, forming a new level of integration and organisation, with a social inheritance and a continuing civility totally unknown among any of the lower forms of life.

Let me raise another point. At no time in Chinese history (apart from a few Buddhist schools) was there any strong development of idealist metaphysics. On the contrary the greatest indigenous philosophical schools tended to be materialist, and therefore disinclined to look for reality anywhere but in this present world. Indeed the Neo-Confucians (corresponding in date and systematism with the European Scholastics) worked out a philosophy based on the concepts of matter-energy and a hierarchy of organising principles which was remarkably similar to dialectical materialism – or as it would be better called, dialectical organicism. And again there was no system of transcendental theology, no doctrine of a supreme creator deity. Confucian *Thien* and Taoist *Tao* were divine indeed, but always immanent within the universe, which had never had a beginning and would never end – at least so far as human speech could say, for it was wisdom to recognise the limits of man's knowledge.

Closely connected with this last fact is the remarkable circumstance that what Lancelot Whyte has called the "European schizophrenia" had no parallel in China. That great chasm of the West between the sacred and the secular, between Pope and Emperor, between the angels and the atoms, was not found at any time in Chinese society. It may have had certain advantages, but it was always desperately open to Manichaean distortions, and the very existence of the Church over against the World meant that it was particularly difficult to visualise the incarnation of the City of God within the actual dwellings and cities of men. Here was another point at which Confucianism mirrored the best elements in Christianity. For the Chinese in all ages, the Kingdom of God could come on the earth, though of course they would never have dreamt of using such a phraseology.

The other indigenous doctrine of China, Taoism, also plays a considerable part in the Chinese ethos of today. To give you any adequate account of this great system of Nature-mysticism would be impossible this evening, but I cannot let the occasion pass without quoting to you a few lines from the *Tao Tê Ching*, the basic document of the faith, written about the 4th century B.C.

> "How did the great rivers and seas get their kingship over the hundred lesser streams?
> Through the merit of being lower than they; that was how they got their kingship.
> Therefore the sage, in order to be above the people,
> Must speak as though he were lower than they,
> In order to guide them
> He must put himself behind them,
> Thus when he is above, the people have no burden,
> When he is ahead, they feel no hurt.
> Thus everything under heaven is glad to be directed by him
> And does not find (his guidance) irksome."

Here we have an extraordinary statement of the principle of leadership from within, not from above. Isn't this directly reflected in the system which the Chinese have been introducing everywhere, that generals should go back and spend a period in the ranks, while chief engineers should go for a month or two back to the bench? Such a principle will surely be embodied in the societies of the future. In this connection we should not forget that throughout Chinese history, and in spite of a great deal of bureaucratic mandarin elegance and superciliousness, there was a classic mystique of the farmer, who came second in the four ancient ranks, *shih, nung, kung, shang*, the scholars, the farmers, the artisans, and last of all the merchants. Distinguished scholar-officials retired to work the ancestral farm. Besides, the scholars never really disdained manual work; in time of adversity they had been known to keep wine-shops, and such occupations as the cutting of seal-stones, the carving of jade and the making of ink were accorded great respect.

Another great watchword of Taoism was *wu wei*, "no action contrary to Nature". Here we have one root, I am sure, of the tremendous emphasis on persuasion which has been so dominant a feature of the Chinese revolution during the past 20 years. The injuries and even execution meted out to the worst bullies of the old régime have been, I am convinced, enormously over-estimated by Western propaganda, and an infinite amount of time has been spent on meetings of persuasion, self-criticism and mutual explanation. Of course in such a vast continent and branch of humanity there must have been some dreadful incidents and miscarriages of justice, but statistically that would be inevitable. What we ought to remember here is that all through the Chinese centuries it is impossible to find any analogy for the religious persecutions and religious wars of the West: the phenomenon of the Holy Inquisition (God save the mark) has no parallel in China. Only when religious groups were thought to be in some sort of conspiracy against the State was action taken against them. This explains to some extent a number of recent events. I am not in any way blind to the dangers of totalitarianism and dictatorship, but with contemporary China we are in the presence of a truly mass movement of millions of people, inspired by the exhortations to altruism of a truly charismatic and prophetic personality. Of course the Chinese party, the Kungchhantang, is committed officially to atheism, but I can say from first-hand experience that down to 1964 at least the treatment of religions was extremely tolerant and enlightened, including the expenditure of great sums on the upkeep and restoration of all temples of any historical or artistic interest. What is happening nowadays I hope to find out next year.

Thus by and large if you reflect upon these ancient characteristics of Chinese society, you will, I think, see what I mean when I suggest that the Chinese socialist revolution, far more perhaps than any such revolution which has occurred in countries forming part of Christendom, may have some at least of the healing principles which all societies of the future will need – how to save their souls in the midst of unbelievable affluence, how to bring the peoples and races into unity, how to ensure that man leaves off animal aggression and behaves as the Man he really is. One must hope that these things will come, one must believe that they will, meanwhile one must practice (as in China they try to do) the greatest of the three, the love of one's neighbour, here and now. It has been said by a distinguished Muslim scholar that all systems deriving from Christendom, even the most secular, atheist and anti-Christian, make love the supreme virtue, but that in Marxism this is a parody of the "charity" of the saints. I disagree here on two counts, first because it can be shown that Marxism has Chinese roots as well as Christian ones (from Neo-Confucian organicism through Leibniz and Hegel), and secondly because I do not believe that there can be parodies of love. The agonising paradox is that of our two commandments "on which hang all the law and the prophets", the Chinese reject the former (and in general always have done so), but by their just and righteous social order they practice the latter much better than Christians do. What to conclude, I leave to your judgment.

The Mind of Man

(i) Ghost Hunting *Patricia Wright*

Some thoughts prompted by the televised broadcast "The Mind of Man" by Nigel Calder.

If wars begin in the minds of men, does it help the cause of peace to have a detailed knowledge of the neural connections involved? This is, of course, a utilitarian variant of the mind-body question, and the television programme *The Mind of Man* did not pose the problem in quite this form. Yet the programme was chiefly concerned with looking at the relation between brain and behaviour, and there may be some advantage in shifting the argument from purely academic considerations to the more mundane level of pragmatics. Often a number of confusions surround the whole issues of reductionism in psychology.* In particular it is not always made clear which aspects of the question are open to empirical support and which are quite incapable of being tested by such means; nor is it always evident that explaining mental processes in physiological terms, even when possible, may not inevitably be desirable.

Let us take the empirical aspects of the question first. Since Descartes proposed that mind and body were separate, non-interacting systems, the proposal has been seriously challenged from many sides. Calder's programme *The Mind of Man* made it very evident that mind and body frequently interact: that on the one hand glandular secretions affect emotional behaviour, while on the other hand voluntary control can be exercised over autonomic functions such as respiration and blood pressure. Mind-body interaction is open to experimental investigation. But it is a precarious leap from the evidence that systems interact to the assumption that if they are not separate then they must be the same – the belief that mind is nothing more than brain. This belief cannot be put to any empirical test. Demonstrations, such as the work of Sperry on split

* This generally seeks to reduce psychological problems to stimulus-response terms and to reduce these further to physiological or even physico-chemical terms.

brain preparations, show only that certain parts of the brain are necessary to certain types of psychological functioning. In the light of such demonstrations it may seem unnecessary to retain the concept of mind, but such demonstrations can never show that there are *only* brain processes involved in mental activity and nothing more.

This point is sometimes forgotten. On several occasions the televised broadcast seemed unaware of the distinction of the brain as a "necessary part of" and the brain as "coterminus with" mental processes. Take for example the illustration of the formation in the brain of the protein S100 when a right pawed rat was made to learn how to reach for food with its left paw. The programme pointed out that biochemically preventing the manufacture of this protein prevented learning taking place, and happily concluded by equating the newly formed protein with what had been learned. To an all-seeing eye, as a statement of fact this conclusion might be true; but that the reasoning behind the conclusion is false becomes clear when analogous reasoning is applied to changes simultaneously taking place elsewhere in the body during the learning of a motor skill.

An examination of the state of the muscles in the rat's left paw before and after learning would show changes that had resulted from the special exercise that these muscles were receiving. Preventing these particular changes occurring would almost certainly prevent learning. But who would wish to conclude that therefore what was learned could be equated with this muscle change?

Although shedding no direct light on the mind-body problem, this reference to physiological processes outside the brain does point up yet another source of confusion that often arises in discussions of this topic. It seems to be frequently assumed that "Mind" and "Body" are each homogeneous lumps which, for the purposes of argument, can be treated as though each was a single entity. Yet such an assumption over-simplifies the problem, and thereby makes it appear much more tractable than in fact it is. In contrast to this approach, most psychologists and physiologists distinguish various levels and qualitatively different sub-components of the processes they study. But if one has to ask which aspects of brain organisation are involved in which kinds of mental processing, then no longer can the results of single experiments provide critical answers for the mind-body questioners. The whole problem becomes much too complex. Consider again the illustration of the rat learning to obtain food with its left paw. What exactly had to be learned? Any rat new to the test situation would, *as a minimum*, have to learn (i) that food was available, (ii) where the food was, (iii) how to get at the food. Under different test conditions these three aspects of the learned behaviour are more easily distinguished, but the pertinent question is which of these aspects of learning would correspond with any observed physiological changes? Furthermore, since with our present knowledge there is little certainty that the neurophysiologist is even looking at the most relevant neurological and biochemical activities, and far less than he is looking at all of them, it is clearly no straightforward matter to formulate equations between mind and body.

But in so far as the difficulties of relating mental and physiological processes have encouraged people to adopt over-simplistic views about the functioning of mind and body, to this extent the whole issue of reductionism in psychology is mischievous. Certainly from time to time Calder's programme slipped into this casual way of thinking of the body as a one level system. Take, for example, the programme's approach to the treatment of illness. It follows that if "Body" is a one level system, then if it should cease to function adequately all the various means of restoring normal functioning should be equally effective. This implies that the alternative ways of, say, reducing high blood pressure can be interchanged with no differential effects on the system as a whole. This viewpoint received implicit support from the programme's showing that volitional control could be exercised over blood pressure level. But if one adopts the alternative view that the body is organized into systems reflecting various levels of complexity, then precise trouble-shooting would seem to be necessary before any malfunction of the system can be adequately corrected. Biochemical or volitional control may serve very well if the locus of the fault in the system was at one of the subordinate or lower levels of brain organisation. But when the increased blood pressure is the result of higher levels of brain organisation attempting adaptive responses to environmental stresses, it might be foolish to prevent a particular response without considering the effect that this will have on the total system. Of course this point has been a bone of contention between behaviour therapists and psychoanalysts for many years. Believing that there is nothing more to Mind than Brain, changes the terminology, but the problem remains. Failure to recognize the complexity of organization of which the brain is capable, makes the problem unhelpfully invisible.

The treatment of illness was not the only occasion where *The Mind of Man* played down the role of organisational processes, in order to be able to offer partial solutions to the mind-body problem. The brain was again treated as if it were a one level system when the issue of localisation of brain function was dealt with. Viewers were led to believe that certain parts of the brain had highly specialized functions, functions which related to mental processes such as talking and thinking, functions which only special parts of the brain could fulfil. The immutability of some functions was illustrated with reference to the effects of tissue transplantations in frog embryos. Tissue which would have developed into skin on the left side of a frog's back was transferred while it was still a tadpole so that it grew on the right side. Nevertheless stimulation of this skin in the adult frog elicited inappropriate scratching behaviour from the left leg, instead of more appropriately from the right leg. But such a demonstration says little about the human brain, which has great potential for overcoming early injury. For example, in normal adults the left cerebral hemisphere is more directly involved in speech and language functions than the right, and damage to the left hemisphere in adults severely impairs linguistic performance. However, when such damage occurs in a young child, before the onset of speech at about two years of age, speech develops—albeit perhaps delayed—but being lateralized in the *right* hemisphere. This cerebral plasticity is most easily understood in terms of the high degree of brain organisation which takes place during the course of human development. It would seem that evolution has left the brain with preferred ways of accomplishing this organisation, but initially alternatives are open. Only once the organisation has been formed, is destruction of some part of the brain likely to result in an irreparable loss of function. The crucial feature is not a particular chunk of brain cells, but a particular section of cerebral organization.

Let us pursue this theme of organization for it is within this context that the mind-body problem is most appropriately set, since both are organized; moreover it is within this context that the question is most clearly seen as of minimal practical relevance. The programme pointed out that concepts such as the conversion of quantity, i.e. the notion that 16 items are always 16 items no matter what they look like in terms of being spread out or piled up, are not acquired by children until they are about eight years old. However this need not be interpreted, as the programme attempted to suggest, as the result of a bit more brain having grown between infancy and childhood. Rather it may be the outcome of particular kinds of organization having taken place in the eight-year old, organization which necessitated other organization having taken place first. Of course it may be equally necessary for there to be more neural material available in the brain to enable whatever re-organization takes place. But to jump straight from cerebral increase to cognitive development may be to leapfrog clear over the most interesting things that happen when a mind grows; and it certainly risks landing in the wrong place if one is interested in helping children to acquire these basic concepts.

But not only is the brain organized, behaviour is organized. This aspect of human behaviour was not dealt with by Calder's television programme, but it relates very critically to the opening question about what goes on in the mind of man. For example, when people learn complex skills they learn how to deal with both inputs and outputs as large integrated units. The differences between the skilled musician and the beginner are, for the most part, differences of organization. The beginner reads a note, plays it, reads the next note, and so on. Gradually the eye-finger span increases but this is only a quantitative difference. The Maestro reads phrases and plays phrases; this is a qualitative difference. Moreover it is a qualitative difference which distinguishes the expert from the novice in many skills such as telegraphing, typewriting and reading. To say no more about a pianist's skill than that certain parts of the right hand side of the brain are necessary, is surely to say no more than that fingers are necessary. If one is concerned to increase the level of skill at which a novice performs, is it not more valuable to study the factors contributing to the organization of behaviour, rather than examining the neural correlates of this organization? The appropriate level of analysis would seem to be inexorably bound up with the question one wishes to answer, the goal one wishes to achieve.

In this sense the pragmatic approach is neither an optional extra nor a superficial side-stepping of the problem. To illustrate this point by way of a cautionary tale, let us consider the reduction of water to its constituents hydrogen and oxygen. Imagine a chief fireman arriving with his team to fight a fire in a timber yard. The Chief turns to his second in command and says, "What we need is two parts hydrogen to one part oxygen". Gas cannisters are sent for, and the jets from two hydrogen cylinders and one oxygen cylinder are aimed at the blaze. Unfortunately, because hydrogen and oxygen are both inflammable the flames spread. Clearly the trouble was the incompleteness of the fire chief's knowledge. At present our understanding of the biochemical and neurological processes in the brain may be similarly incomplete. But the real point of this cautionary tale is that when solving problems at an inappropriate level of reduction, if all goes well the cost is simply a lot more work for the *same* adequacy of solution; but there is always the risk that where knowledge is incomplete the solution arrived at may be badly wrong. There is no sense in which a move in the direction of greater reduction is a move nearer "the truth". Even though mind may be reducible to brain, and brain in turn may be reducible to the elementary particles of sub-atomic physics, some levels of analysis are undoubtedly quite irrelevant to answering some kinds of question. And there would seem to be no a priori reason why theoretical constructs found useful at one level of analysis should be abandoned because they serve no useful function at a different level. Whether or not "mind" is ever a useful construct is to ask a different question – a question which is inappropriately answered by insisting that, because mind is coterminus with brain, mind is an unnecessary label and simply a legacy from a bygone era of misconceptions.

Finally let us turn to the question of conscious awareness. Mind implies consciousness, and it has been this issue which has resulted in most of the blood-letting in the arena of the mind-body problem. Yet it is hard to see how any evidence can be cited that would carry conviction for those of the opposite persuasion. Certainly it is quite inadequate to attempt, as the *Mind of Man* attempted, to argue from the observation that brain injury results in a loss of conscious awareness (for the sake of the argument let us ignore the fact that it was specifically loss of *memory* which was demonstrated in the experiments shown) to the equating of consciousness with the brain location damaged. As was pointed out earlier, the most that can be said as a result of such studies is that particular regions of the brain are indispensable to certain psychological functions. In principle it is conceivable that future research may establish that physiological explanations are sufficient to account for mental processes, but this would not mean the inevitable abandoning of mentalistic concepts. When the use of any particular concept is associated with a high theoretical payoff, this may be sufficient justification for its continued existence. Certainly work centering on psychological terms such as Attention, Decision Making, Concept Formation, etc. have yielded genuine and valuable insights into the organization of behaviour.

The software-hardware distinction is now common place. No-one needs homunculi to explicate the performance of computers. Nor does the relation between these two levels of functioning receive much attention. Perhaps a similar approach might be usefully adopted by the mind-body problem solvers. Perhaps it is time that we out-grew the pre-occupation with this particular form of ghost hunting.

ii. Central States Materialism

Michael Morgan

Calder's "Mind of Man" was unashamedly materialistic in its approach, and many people will probably think that it had better been called "The Brain of Man". This philosophy could not have been otherwise in a fair survey of trends and fashions in modern psychology, and the programme was nothing if not fair and accurate. Most psychologists now seem to believe that their proper function is to study the brain; exceptions like Skinner who stress the study of behaviour are coming to have less and less influence. Being sensible scientists, neuropsychologists do not bother themselves over much about the philosophical implications of their working beliefs. They just get on with the job. This is just as well for them, because the belief that "the brain is the organ of mind" runs into obvious difficulties.

The strongest version of the "brain hypothesis" states that mental states and brain states are indistinguishable. This doctrine is called "Central States Materialism" (CSM). The common sense conviction that minds and matter differ is a delusion of language, according to CSM. Suppose two children cannot agree whether to call someone they know "Uncle Bill" or "Mr Thomas". If Mr William Thomas is their uncle, they are referring to the same person. Similarly "sensation of green" and "excitation of retinal ganglion cells" need not describe different things. We are quite mistaken in thinking that the possibility of these two different descriptions implies separate things called "mind" and "body". There exist only material happenings in the brain, described as neural events by those in the know, and as experiences by the brain in which they occur.

This theory replaces older versions of materialism in which mental events arise from the neural substrate as uninteresting and impotent "epiphenomena". Precisely what is wrong with epiphenomenalism is that these mental events, being epiphenomena, have no function. Therefore they cannot be explained. As Bergson put it, "Tout réalisme fera donc de la perception un accident, et par consequent un mystère."

CSM is not merely saying that neural and psychic events are *related*. Rather they are supposed to be *identical*, which is what Calder presumably means when he suggests that "the brain *is* the mind". Unfortunately, the language of CSM is so rigorous and counter-intuitive that even its adherents cannot keep it up for long. As a perfect example of what CSM is *not* saying, and what we must all avoid saying, consider another of Calder's remarks: "We have to show that the brain tissue not only carries the coded versions of sights and sounds but also perceives them. . . ." This is old fashioned dualism, of a particularly pernicious variety (the "ghost in the machine" fallacy, as Gilbert Ryle so memorably called it). According to CSM the coded version *is* the perception; the brain shouldn't be also talked of as if it were a little man in the skull puzzling over the code's meaning.

Inconsistencies apart, "The Mind of Man" is obviously committed to the identity hypothesis. And the case it presents is almost overwhelmingly convincing. The personality of a chimpanzee is controlled from a distance by radio waves; electrical stimulation of the human brain evokes memories and feelings; chemical compounds change the emotions in a profound manner; removal of neural tissue produces crippling psychic defect. Perhaps most convincing of all, splitting of the brain into two halves produces two independent minds in the same body, proving as Ernst Mach suggested long ago, that "the ego must be given up".

Only the most crazed idealist can pretend in the face of these facts that the mind is an autonomous agency. For him there is no problem, since all the facts so patiently collected by Calder and his colleagues are merely events in the idealist's mind, and cannot in the least shake his opinion that only mental events have any reality. This hypothesis having no known refutation it is conventional to dismiss it as "an insult to common sense", or something similar.

The chief offence to credulity posed by extreme idealism is, of course, its denial of other minds; the whole pack of psychologists, neurologists, neurophysiologists, anatomists, and psychoethnopharmacologists, as well as Calder and the BBC, must be considered actors in an absurd internal drama, the only purpose of which is to vex my mind with bogus data. Even Aristotle's theory that the function of the brain is to cool the blood is a welcome alternative to such selfishness.

But is CSM in the long run going to prove any more acceptable to common sense? A considerable obstacle to its general acceptance, I believe, is that it fails to account for the general belief that there is a mind-body *problem*. Why do our brains find the notion of an identity between experience and neural activity so difficult to accept? Tell the man in the street "Neuron No. 1090*m2 in brain 987/009 is firing" when you mean "I think your wife is charming", and he will treat you as an impossible eccentric. Show him a piece of brain and say "look at that sensation of green": he will probably have the degraded persistence to call you a madman. That a sensation can "arise from" the brain he may be prepared to admit, but that they are identical, never. Of course, common sense can be mistaken, as its enemy the scientist never tires of pointing out, but that is not the issue here: we are not dealing with something like the roundness of the earth, but with the brain's knowledge of its *own workings*. "Belief" according to CSM is just a state of the brain. Why, then, should the brain so violently oppose a theory that increases the brain's importance? How does it happen that neural events are so mistaken? Calder's claim is just not true that the brain "is a machine conscious of its own existence". We are not at all conscious of our brains, nor are we conscious of any events in our brains, with the possible exceptions of headaches. Common sense persists in thinking that sensations differ from brain states. CSM, as a psychological theory, must not be content merely to point out the error of common sense: it must explain why the error is made, and what is to be done about it.

An entirely frivolous answer to this difficulty for CSM might begin by pointing out that the brain, as a machine, is subject to the known logical limitation of machines. No machine can have knowledge of its own precise state at any instant, because such knowledge, being a state of the machine in its turn, upsets the machine state that it was trying to "know". Consequently, the search for self knowledge is self defeating. Faced with such a paradox, the brain may well have invented dualism in disgust, concluding that its thoughts are unknowable, and hence in a different domain. I have called this argument frivolous because I don't believe it. Unfortunately, no better explanation of my brain's opposition to CSM "comes to mind".

Body, Brain and Mind [1]

Geoffrey Jefferson

There have been those, and many, in the past who were unable to believe that the brain alone could be the source of mind – mind which is a function and not a thing. And of course, in a strict sense, by itself it is not, being no more than the final end-station on which the vast nervous system converges and supplies it with its information. In what follows I shall rather artificially speak sometimes of body and sometimes of brain, but brain is a part of body and indeed the nervous system is so intimately woven into the body that no parts of it, not even the viscera, are free from nervous elements. It was this anatomical fact, discovered long before the physiologists were able to analyze what happened exactly, before they could show what were the mechanisms by which messages were carried by different nerve fibres, that led to confusion on the location, let alone the mechanism, of the production of mind. In older days there was a widespread belief that mind or soul was extended throughout the whole body, a view volubly put forward by the Stahlians in Queen Anne's time. If a limb were chopped off a fraction of soul went with it. To this day the question whether the mind of a man is lessened when he loses an arm or a leg or an eye or his hearing, remains a good subject for undergraduate debate. We can properly content ourselves by agreeing that physical disabilities affect us and impair us only in so far as they reduce our powers for increasing our experience or making use of experiences already gained. The effects must differ, therefore, not only with the nature and situation of the injury but also with the age at which it is suffered. We must remember that to some few gifted people disablement has conferred benefits by curtailing opportunities for diversion, by compulsorily conserving energy and canalizing effort. They have been thinkers, poets and writers rather than men of action.

The key-fact of body-brain relationship is that brain is so dependent on body that it cannot exist without it. The body provides the

[1] A contribution by the late Sir Geoffrey Jefferson, F.R.S., speaking as a neurologist, in a discussion on "Minds and Machines" held some years ago in the Department of Philosophy in the University of Manchester.

energy for its nerve cells, which make great demands on the body's chemistry.

The brain's sensitivity to the body's chemistry leads me to mention the central over-riding controls situated in the hypothalamus and perhaps in the adjoining basal ganglia. Here chemicals or their lack act as the excitors in place of the nervous impulses which are the usual method of excitation in the nervous system. The most striking example is the respiratory centre but there are few systems that do not have their cerebral remote controls. The brain has in it a number of delicate calibrators (Verney's suggested "osmoreceptors" are good examples) measuring the chemical constituents of the blood supplied to it within a band of the upper and lower limits of its normal demands. Some are thermo-regulators that adapt the temperature of the blood to environment and physical effort.

The importance of these cerebral controls of general metabolism, indeed their very discovery, has been a feature of research during the last 20 years. It was a fascinating discovery that nerve-cells responded not only to impulses reaching them along nervous pathways but that some special cell groups were sensitive to chemical stimuli. It seems to me that the discovery of the hypothalamus and of the brain's eventual participation in metabolism gives the answer that philosophers sought for so long. When they had to regard brain as a purely mental organ they were puzzled by its sensitivity to bodily ills, by fatigue, by being just "out of sorts", by the way that its actions were ruffled by the emotions (the passions, as they said) of the soul. But if their discovery had an importance for the philosophers they had a greater import still for the doctors. It is because of their presence inside the skull that cerebral injuries and diseases are dangerous to life, for otherwise the most serious should have led to the mad-home rather than to the grave.

One can only look at the body as a machine with many reservations, but with these in mind we see that the body the whole time measures its metabolism and corrects any divergences likely to be harmful. Thus the circulatory system and the heart, do, as it were, take notice of the pressure that is being maintained in the blood vessels by means of calibrators, its "feed-backs" in modern parlance. It is through the nervous system that most of these controls are exercised in the long run. It does these things because it must, without thought, for all of them are completely beneath our awareness. Cannon summed it up in his phrase "The Wisdom of the

Body", or more briefly homeostasis. [2]

Although we are unaware of them, these controls are certainly linked up with the cortex from the hypothalamus. We are not finding the connecting pathways easy to discover and we still lack news of any highly important bundles unless they are those that come from far back on the orbital surfaces of the frontal lobes. But there is no doubt that there is a two-way traffic, from the cortex to the hypothalamus as well as in the other direction, or at least we judge from the effects that thinking disturbing thoughts has on the colour of our cheeks, sweat glands, on our digestion, the movements of intestines and bladder. These are the effects of emotion and, as for emotion, we can be certain that it enters into all the actions of our minds. We know well how the emotions can disturb our thinking, notably on occasions that cause fear or embarrassment. If emotional or affective drives become insistent and devoid of normally adequate cause they make concentration and right judgment impossible and render us fit subjects for admission to Mental Hospitals. We should call these changes emotional. Now, psychiatrists regard mental disturbances not due to organic disease (and many are not) as essentially the result of lack of emotional balance, as affective disorders. Emotion they say, is so woven into thinking that it can be found in all that goes on in our minds. Emotion and instinct go hand in hand, and so animals seem to be much more emotional than men. The development of the cerebral cortical mantle has provided us with more powerful inhibitions which serve us well enough. And yet so powerful are instincts and emotions that they may disorder the patterns of our lives or in milder forms cause us acute embarrassment. Charts of simple vocabulary and intelligence tests on an emotionally unbalanced young man of good education before and after he had had a selective leucotomy (cingulotomy) may show a vast improvement in his thinking. The operation of leucotomy has been found to serve by reducing the lower level drive of the emotion on the intellectual powers of the brain. To use Freeman's phrase, it "bleaches the affect", and thus it can make the emotionally deranged think better although their brains have been damaged. The one great lesson that runs through all my experience of brain surgery is that however much a person is changed by disease or injury of his

[2] Walter B. Cannon first used the word "Homeostasis" in his book *The Wisdom of the Body* (1932) to describe stabilizing devices in the organism, such as those regulating sweating. (Ed.)

brain he is never changed into somebody else but only into some modification of himself. I can sum up my experiences with the conclusion that the effect of any brain lesion on the personality of the individual depends on the answer to the question "who was this person before the disorder started, what was he or she like?" We are all *different* and all imperfect, and in those qualities we differ from the machines we know.

I spoke of two ways in particular in which body is linked to mind and so far I have dealt with but one, body as brain energizer and an important partner in the emotions. I come now to the part played by body as a vehicle for the outriders of the brain, in the form of the peripheral nerves and their endings, to the cranial nerves and the special senses. The particular importance of the human hand for instance is not alone all the clever things that it can do but its extreme adaptability for exploring our environment. So all our body and limbs, our sight, hearing, touch, smell, taste are means by which we explore our environment. Our nervous system is the means by which we collect the data of experience, by which we store them as memories, by which we make use of them for the satisfaction of our needs. If we look at the evolution of the nervous system, we see it as a developing means of increasing the powers of its possessors to acquire, to store and to use the experience provided by the environment (physical and biological). That, in brief, is as good a definition as I could give of what the purpose of the brain is – to collect, to store experience, and to make use of it. Body helps brain by giving it increased possibilities to be aware of the world in which it lives and finally, in man, to form concepts about it. And not only about that relationship, but about itself, the ego, an awareness of self as an individual which we, possibly rashly, assume that animals lack. How dependent the brain is on its communications, which the body carries and protects for it, we know by the constant traffic of impulses passing up our nerves and spinal cords entering through our eyes and ears and entering our brains. We know that the nerves are never silent but it would perhaps bring it home more clearly if we were to imagine that each member of today's audience had an electronic pick-up in his spinal cord connected with a loud speaker. If that were so the roar made by the impulses streaming up would make such a noise that my voice could not be heard.

These observations strongly suggest that the inflow, the afferents of the nervous system, are important to it. Not merely important, I should myself say, but vital. For the mind must be given by its afferents richness and variety of experience, be given a wide selection from which choice can be made of those things that have a singular attraction, importance or usefulness, so that choice may be made from variety. The Wellsian idea of a hugely developed brain on a perfectly insignificant and almost stationary body was a complete misconception, because what matters is not brain alone but opportunity for collecting the information which is the raw material for thought. We witness in body-mind relationship the wonderful partnership between body and brain, brain using body as a means to enlarge its experience by movement, and body providing brain with opportunity for pleasures of different kinds, body providing brain with the energy, the varied fuels which it consumes, brain responding with concern for body's welfare and taking care to ensure it. These interplays are largely unconscious and many are carried out, as I have mentioned, by ingenious regulators, governors or feed-back mechanisms. At this point we may enquire fully how mechanical is all this? Is everything predetermined? Do we do all that we do because we must, because that is the way we are wired?

I have no doubt that many of our thoughts, our decisions, our actions, are much more predetermined than we imagine. Our opinions are largely the fixed ideas that our brains trot out when the given stimulus is applied – as perhaps is happening to me now. Much has properly been made of men's ability to choose and judge. We agree that in range and particularly in concept and abstraction human beings have great advantages over other animals. All animals make choices of course, they must do so to live. But very many of the choices we make in our daily lives, whether it be simple things like choosing dishes from a menu or deciding whether to take an umbrella, are familiar problems. Most of the time we do what we did yesterday and will do tomorrow. I fancy that many a man with a repetitive, routine job might go through a whole day without thinking much. So routinely do our lives run that our problems are often only just above the level of animal intelligence. I take it that difficulty in choice increases sharply the more experience and conditioned reflexes fail to render the solution easy. We are made positively uncomfortable by difficult choices. In all events it is probable that we shall say or do this or that as our personalities and individual histories dictate. I do not think that "free will" has much meaning for the physiologist, who rejects the doctrine of rigid automatism for nervous systems rich in synapses. Man's range of choice is so varied and the personal history that influences his decisions not only so colourful, but its ingredients so plastic and of such changeable weight, that there are enough variables to make "will" to all intents and purposes "free". In choice between several evenly balanced possibles, chance might be the final arbiter. But no man in his senses can deny that man *can* over-ride by an effort any mechanical trends to take such and such a course and can do what he thinks right. Perhaps that is what we mean by "second thoughts".

It is noticeable that it is commonly in his misdemeanours and his failures that man complains that he is the plaything of the gods or the victim of his genes.

I have recently had occasion to discuss what I called "The mind of mechanical man". I concluded that although there are close similarities between the actions of some specially constructed electronic circuits and the simpler types of neurons found in the spinal cord, we have no right to conclude that this has solved for us the vast outstanding problems of neurology and psychology. It may be that this is all they are, but it cannot be proved. The fact that there are many in this mechanistic age ready to jump ahead of the facts is interesting, but neither their number nor their names gives any authority beyond the meagre facts. The new anthropomorphism is not of God but of the machine. The caution of my own approach does not mean that I believe that mind, if it is not electronic, is necessarily supernatural. What I do say is that we do not know how nervous impulses are converted into thinking, and my reading of the history of science has taught me that our chief errors have been in solving the riddles of Nature by stretching an explanation to cover something where it does not really apply. We must therefore make our excursions into the unknown fully realising that we may be using the wrong instruments to guide us. On those terms and on those alone the electronic experiment is interesting and possibly rewarding. So far it cannot be carried beyond analogy with the simpler sense impressions up to the point of their arrival in the brain. It is then that the real mystery, or if you prefer it, our real ignorance begins. Consciousness itself, by which I mean not only response to but awareness of our surroundings, is I believe arranged for at sub-cortical level. A very primitive nervous system suffices for consciousness. Animals are extremely alive and conscious without being markedly intelligent – witness the behaviour of the dog (though I fear that that remark will bring deluges of expostulation). So that for me at least intelligence is not the same thing as consciousness though the latter must be present for mind to make itself evident.

I have pointed out that the essential basic fact about the nervous system is that not only the sensa but the percepta of most of our experience are wordless. Animals have the same sensory mechanisms for seeing, smelling and hearing (some better than ours) for selecting data and perceiving them but they, like most of ours, do not need speech. In us the power of making those interrupted tone-laden sounds which we call speech is infinitely richer than anything that the animal possesses. But I am sure that the prototypes of speech exist in lower animals and find their expression through voice and gesture. They must, and do, express much by their whole body responses, being deprived of the sectional richness that our own body gives us. But gesture too in man is much richer and much more embued with nuance than in the animal. What is so funny and so delightful about the pantomime cat or horse is to see it making gestures that are entirely human, the beckoning paw, the wink, the shrugged shoulders, the expressive posture. We see in these artificialities the elaboration of something that we have in common, and recognize what we had hardly suspected, that even simple gestures require a richly integrated nervous system to permit their use. So it is with the voice and the power that it gives us to express concepts. But surely here too the power to express concepts depends on the power to formulate them. This is the fundamental difference where man rises high above all other species.

This global survey had I hope touched on enough points to allow of others to fill in the picture in greater detail. I have mentioned the dependence of brain on body, indeed its inseparability (because body is the source of its life) and on the uses of the body not only in supplying it with sensations (messages) but of its enormous value as a vehicle by which brain can enlarge its experience by exploration. I have touched upon the mechanistic view of mind, a suggestion that I think we shall eventually reject however seductively the mechanical sirens sing. I believe that man is master of his fate and that it is his mind which makes him so – mind which is created out of experience by our nervous systems which do it in their own way, a way not identical with other non-biological physical systems.

Cree-Country Christmas Cards

Arthur Bell

Hurray! Christus Natus Est!

BLEAK in close of snow-clad spruce
  Afar the white width fling
Frozen shell in chilling wind
  Ice stick mistik* sing:
    Frosten crust
  Thick hold of fur
Friend dug in living death;
  Fur for the home
Warmth hid find full,
  Fur for the naked King.

****Mistik: multiple meaning: Cree: "stick", "log", "mile" (many mistikok needed to keep the cabin warm).***

Born, A World Engraved

BORN amid the mauve and purple twilight of the moonlit skies;
Born, the creature doubly mortal of the two great spheres of light:
    Earthed before us
    Grounded fulness
  Heaven swings swift the close day's note.
Deep the forest, dark the water: bare the bones of winter's rib:
Through the iceness still and silent sings the keen cut chill crack'd
  blast
    Bright and warm the distant cabin:
  Man stands double strangely sole.
Hasten onward, lonely hunter; day ends ere you reach your goal:
"Run! Come quickly! " calls your partner! Yet he stays, no sound,
  no move.
    Bare thick ice;
    The Lake light crystal;
  There the world in sculptured soul.

A Wild Snow-storm Over The Freezing Lake Wabiskaw

CHILL frost storm,
Sing wild growl:
Wing flattered streak,
Grand the awful tempered triumph.
Ice and snow dapple the water,
Move with the music in flurried gasp:
Mist of the snowness into the newness
Clean the guts of home and hearth.

Review

The Environmental Revolution: A Guide for the New Masters of the Earth, by Max Nicholson. Hodder and Stoughton, 1970. £4.20.

To summarize, for the benefit of those who read reviews to see whether the book reviewed is worth reading: this is the most important survey of environmental conservation that has yet appeared. Its importance lies in the fact that its author is a leading conservation scientist and administrator; that it treats difficult problems with the seriousness they deserve; and above all that it presents, with disturbing clarity, the state of the art so far. It is important too, in its interpretation of current events in the conservation field as amounting to no less than a revolution.

Unfortunately, the word "revolution" is often used in rather a weak sense nowadays. It is easy to say, "such and such a revolution is occurring" when what we mean is, "people are at last beginning to think about such and such", or even "such a revolution *ought* to occur". And when the alleged revolution does in fact occur, it is often no more than a series of piecemeal and unrelated actions performed in an unco-ordinated and somewhat defensive manner. This is certainly true of much of what has happened in the natural conservation movement; for example, efforts to combat oil pollution, chemical pollution, and smog. Max Nicholson sees (and in my opinion, sees truly) that the conservation movement has passed through this phase, and is becoming locked in a full-scale confrontation with technological civilization. Technological civilization, he claims, "has entered a phase in which it virtually acquires a will and a strength of its own, tending to dominate and bend to its necessities even the most powerful human rulers and groups" (p. 282). And there are many who would agree with him.

If this indeed be so, it is clear that it can only be mastered by a revolution, and a strongly planned and co-ordinated one at that. His claim is that the conservation movement is in fact best placed to engineer the overthrow of the autonomy of the current technological system, or "technosphere". (It is important to grasp the point that what is being attacked is not our technology, but the fact that it seems to have acquired a capacity for working in an uncontrolled and undesirable manner.)

The terms of reference of the book are stated very clearly in the foreword: "If our environmental revolution is to prove less of a shambles than most (revolutions) we must correctly marshal the events and forces leading up to the present situation, evaluate the weaknesses, the mistakes, and the progress which has been made, and find a sound and acceptable basis for judging where we go from here. That, roughly, is what this book is about." And it becomes clear that his word "we" does not mean an anonymous "they". The New Masters of the subtitle include me and you: all must become involved in the environmental revolution.

With what success, then, has the author carried out his stated intentions? How informed are his evaluations? How good is his judgment? How practical his plans?

Firstly, as to his qualifications for the task. Max Nicholson has an international reputation as a leading worker in conservation interests. Although he is a keen field ornithologist, his role in the conservation movement has been mainly that of an executive, hammering out policies and becoming involved in the management rather than the observation of nature. The Nature Conservancy owes much to his direction as do the conservation interests in the international biological program and (of course) various committees innumerable. But he is a committee man in the very best sense: one with a firm grip of what is going on, and with sufficient force to get his concerns implemented.

We expect then a book of authority, coming from one who has been closely involved in a significant number of official conservation movements since the last war; and in this we are not disappointed. As an historical survey of man's relationship with his environment, this book could hardly be bettered. But this is not a comfortable survey to read. It is not so much the major errors of judgment and catastrophic boobs that cause a feeling of despair so much as the countless thoughtlessnesses and general greed that has characterized our relationship with the planet we live on. However, although Dr. Nicholson gives a fair amount of space to describing both serious and minor examples of misuse, yet on the whole his tone is more one of optimism tinged with sadness rather than pessimism. This makes the book all the more worth reading, because (one feels) if someone as well placed to judge as he is finds encouraging signs, then who are we to give up in rank despair? As to the nature of the signs, there is more to be said later in this review.

The book does not aim to be just a survey. It is (as it says) "A Guide for the New Masters of the Earth", and the survey of the past and present state of conservation is just an important preliminary part of the guide, so that the guidance given is built on a good foundation. The trouble is, of course, that "Where are we?" is a much easier question to answer than "Which way do we go?". Indeed, it is not clear that there is a way ahead apart from the disastrous one of capitulation, and making more deserts by means of more and more vehicles, armaments, pollutants and sundry interferences. If there is an alternative, if we can restore man's authority over the technological monster he has created, it must at the very least involve a vast re-education of human beings and human institutions. This might seem a hopeless task; but the author thinks that it can be performed, and he produces two main reasons for his belief. These are, firstly, that conservation is an idea whose time has come, and secondly, the potential of the computer.

In fact, the purpose of the preliminary survey is to press the point that conservationists are better placed than most to fight this particular revolution because (partly through the leadership of people like Max Nicholson) they are better organised and better aware of what it is we are fighting. Whether the survey will convince you is not for a reviewer to say; I can only report that it changed my opinion from "I don't think the conservation interests are strong enough to fight the technosphere" to "I think, given a few years at the current rate of progress, that they could be". Not much of a change, perhaps, but definitely a change in the right direction; and if the book altered my opinion, it could alter the opinions of others. This is another reason why the book is important.

The other hope that the author sees is in the use of the computer. This put me on my guard immediately, for several reasons. Firstly, one normally thinks of the computer as being part of the technosphere, a servant of the enemy; taking over the running of factories, creating jobs whose sole purpose is to stuff the maw of the beast with raw data, creating vast databanks of personal and private information, so that your police record can be examined before it decides you are eligible for sickness benefit. Secondly, too many people invoke the computer as a kind of demi-god, in a way that formerly they invoked priests and (later on) doctors and scientists. "This problem can now be solved, thanks to X" is a cry that has been heard before, where X has been God, The Church, Medical

Science, Technology, The Computer. A *deus ex machina* indeed! And thirdly, there is generally still too little appreciation of either the scope or the limitations of computers. To claim that a computer can help in a certain area is to raise questions such as, "Are the problems in that area sufficiently understood?" If so, can the variables involved be quantified sufficiently to come within the scope of current computer expertise? For example, a lot is known about the problems of combatting economic inflation, but no-one (to my knowledge) has yet made a computer model of the economy sufficiently complex for it to be used to try out various remedies. Many more models of all kinds of things have been started than have been finished.

Unfortunately, Dr. Nicholson does not go into much detail about how he envisages the computer being used, nor does he show how it has already been used in the aid of conservation interests. But since he clearly regards it as being very important, I would like to expand on this topic, in an attempt to justify his claim (p. 284) that "Only by developing computer methods harnessed to ecological principles and insights can the rival world of the technosphere be mastered in the interests of both man and nature." The danger is that his readers will be suspicious, as I was, unless further amplification of this vital point is made.

I want to start by taking stock of how computers have already been successfully used in conservation and related fields. The uses I shall discuss all share one thing in common: they are all models. The word "model" implies that certain simplifying assumptions have been made, and certain factors neglected, so that one cannot expect from it all the answers. For example, a model of the British economy might assume that the birth rate over the period being modelled remained constant, and it might ignore any side effects due to, say, a devaluation of the franc. With this caution in mind, we can look at certain actual or potential models of environmental situations.

One model is that of duck population used by the U.S. Fish and Wildlife Service. They feed in information such as how many duck were shot last year, whether there is a surfeit or deficiency of food in the duck breeding area and so on, in order to estimate future duck population and therefore how many hunting days to permit. Other models have been made of such things as salmon hatcheries, the spread of the highly infectious tomato blight in an area, and the major ocean currents in the Pacific.

These programs can obviously answer the questions they were designed to solve, such as: "I've got tomato blight in this field; how many fields are likely to be infected before the crop picking starts in three weeks?" or: "An oil tanker has broken up at such a place in the middle of the Pacific; which islands will be polluted and when?" But there is more to it than that. You can use the model in so-called "conversational mode", where you are connected to the computer via a typewriter terminal and the answers to your problems are typed back to you immediately. This is a way of gaining accelerated experience; you can explore the long-term effects of, for example, various ways of managing a salmon hatchery, in terms of population increase and decrease.

The above examples were all of models that have been made to work. Now they may seem fine, but only of limited application. How does this sort of thing help us in our fight against the technosphere? This is fair comment. The answer lies in starting from simple models like these and working upwards through more and more complicated ones. I shall now give two examples of more difficult models, neither of which has yet to my knowledge been programmed; but enough is known about the real-life situation to make the model a feasible one, given the human and computing resources.

The first is that of a typical English bluebell wood. The number of flowering plants in the spring depends to a large extent on the amount of light available, and this in turn depends on how many years it is since the wood was last coppiced. Other factors are involved, of course, such as the level of the water table (bluebells prefer the drier parts of the wood), the earliness or lateness of the spring, and so on. It would be possible to extend the model to cover all the commonest plants in the wood, such as primroses and anemones, and build up a picture of the changing pattern of vegetation through the coppicing cycle of 12–15 years. I am aware that nowadays coppicing is generally an uneconomic way of managing timber production, but more and more County Naturalists Trusts are taking over woodland management more for the purpose of providing a place of recreation and natural beauty than for producing bean poles and ships' masts. A model such as I have suggested could be very useful in deciding when and how much to coppice in order to keep the floral display.

The second model springs from a recent working party of farmers and conservationists organized by the Royal Society for the Protection of Birds. After the participants had walked a 400-acre farm, the farming syndicate had to produce plans for the farm which would produce an annual profit of £4,000, and the conservation syndicate had to produce plans to improve and enhance the wild life of the farm. Not surprisingly, the main clash came with what to do with the hedges (and this may well prove to be the major problem over the English countryside during the next decade). The farmers' plans grubbed them all up, and the conservationists wanted them kept. In the light of the plans presented, the Agricultural Advisor for Gloucestershire attempted to find a compromise. He succeeded in finding a plan that kept most of the wild life habitats without sacrificing too much of the efficiency of the farm. But there was, of course, a cost; his plans would have reduced the profitability of the farm by £400 p.a. The point I am making is that there is no reason why the calculations undertaken by the Agricultural Advisor could not have been done by a computer; the computer might even have found a plan which reduced the farm income by less than 10% of the profit while still keeping most of the hedges intact, with their flora and fauna. I see no reason why a computable model of land used on this kind of scale could not be made by a good Advisor working with a sufficiently bright programmer.

The question now raises itself, can the technosphere be regarded as a giant biological system, akin to a bluebell wood or the land within the confines of a farm? There are certain obvious parallels: the standing crop of capital equipment, the need for input analogous to cattle food and fertilizers, the horrible demands for land of a certain kind regardless of to what use that land is already being put (Salmesbury), and so on. More appallingly, there is the problem of its unutilized and discarded elements – whereabouts on the farm is it best to place the rubbish heap? Now I am not claiming that this way of looking at the technosphere is a valid one; but conservationists do have the opportunity, right now, to take up the challenge of helping to construct, evaluate and understand the making of models of the biosphere. In so doing they may well find the way to extend such model making to the world of technology and so stop and possibly reverse the process of desert making which (as Dr. Nicholson states) "was started by prehistoric illiterates and is continuing at this moment faster than ever before".

That is what this book is about. If this is the right way to go from here, then we must apply pressure so that the conservationists get the support and resources they badly need. This means that we must understand what the conservationists want to do; and this book gives that understanding. It is an important book.

John Dobson.

Comment

Drugs of Hallucination

Reading your discussion on "The teachings of Don Juan: a Yaqui Way of Knowledge" makes me wish to draw your attention to a book *Drugs of Hallucination* by Sidney Cohen, of which a U.K. edition has just been published by Paladin at 10s.

"Have you or Haven't you? That is the Question?" As R. Gordon Wasson has pointed out with gentle sarcasm, 'We are all divided into two classes: those who have taken the mushroom and are disqualified by the subjective experience, and those who have not taken the mushroom and are disqualified by their total ignorance of the subject.' So wrote Timothy Leary in his book *The Politics of Ecstasy* which was published last year in a paperback in this country. Leary is crazy and prophetic, learned and silly, wise and naive, and his brilliance attracts as much as it repels.

Sidney Cohen's book is written from the position he holds of being Director of the Division of Narcotic Addiction and Drug Abuse at the National Institute of Mental Health in Maryland. Psychosomatic medicine has been his study for many years, and he has investigated problems connected with LSD and other hallucinogens, contributing some of the basic research in this field.

This book came out in 1965, and there is a clear break between the first three quarters of it, and the last chapters written when he has been face to face with the tragedy of drug abuse in the States. He begins in high hope and ends with a great sadness that so possibly valuable a mode of inward exploration should have been so greatly abused that now it is almost impossible to find first class people who are willing to experiment. "The present cast will have to leave the stage before a more hopeful, new beginning can commence."

His book covers the whole field: The chemistry of the hallucinogens, tables of comparison between sensory deprivation result and drug result, psychotherapy with LSD, Pro and Con, the dangers to the patient – and the therapist, model psychosis or Instant Zen? the worst that can happen, and the Latter Saint's Day.

I read this book as One Who Had, as I had taken part in a pharmacologist's experiment some years ago, and I was particularly interested in Cohen's comment on the difference between spontaneous visionary experience and psychedelic experience, saying that he believed that despite the similarities, the spontaneous must have a much greater impact on the person. This would depend I think on whether it happens that a hallucinogen experience precipitated a true "gateway" experience.

By a gateway experience, I mean one which follows a long period (years often) of search, doubt, struggle, experience, resulting in the mind finally laying down its task, and succeeding in crashing through a layer of consciousness and being "initiated" into a deeper mode of living. A gateway experience leads into a richer world of experience in living, and denotes the deeper surrendering of the ego. "Ski-lift transcendence can approach that of the mountain climber's only if the prior life preparation has also been one of training and self discipline", says Cohen, and here one must agree with him.

The book provides case histories of all kinds, including those of people (like many *T. to T.* readers) who have spiritually disciplined themselves over many years. I too though, with Cohen, have encountered people with rather marked alterations in character induced with the help of LSD which do not seem beneficial. "Previously held aspirations, goals and values may be lost. Motivation to study or work disappears, family ties dissolve and personal cleanliness is neglected. Speech consists of pseudophilosophic jargon. . . . Following an LSD experience the return can be accompanied by a loss of belief in such cultural values as right and wrong, or good and bad. This happens ordinarily to people with already attenuated ethic."

It is of interest that the Friends Yearly Meeting in New York this year included a session on Hallucinogenic Drugs.

Damaris Parker-Rhodes.

20 Sedley Taylor Road, Cambridge.

Sentences

Two poems by Gerard Manley Hopkins.

I. *Inversnaid*

This darksome burn, horseback brown,
His rollrock highroad roaring down,
Incoop and in comb the fleece of his foam
Flutes and low to the lake falls home.

A windpuff-bonnet of fáwn-fróth
Turns and twindles over the broth
Of a pool so pitchblack, féll-frówning,
It rounds and rounds Despair to drowning.

Dregged with dew, dappled with dew
Are the groins of the braes that the brook treads through,
Wiry heathpacks, flitches of fern,
And the beadbonny ash that sits over the burn.

What would the world be, once bereft
Of wet and wildness? Let them be left,
O let them be left, wildness and wet;
Long live the weeds and the wilderness yet.

II. *Binsey Poplars* (felled 1879)

My aspens dear, whose airy cages quelled,
Quelled or quenched in leaves the leaping sun,
All felled, felled, are all felled;
Of a fresh and following folded rank
Not spared, not one
That dandled a sandalled
Shadow that swam or sank
On meadow and river and wind-wandering weed-wandering bank.

O if we knew what we do
When we delve or hew –
Hack and rack the growing green!

Since country is so tender
To touch, her being só slender,
That, like this sleek and seeing ball
But a prick will make no eye at all,
Where we, even where we mean.

To mend her we end her,
When we hew or delve:
After-comers cannot guess the beauty been.
Ten or twelve, only ten or twelve
Strokes of havoc únselve
The sweet especial scene,
Rural scene, a rural scene,
Sweet especial rural scene.

Kenneth W. Merrylees graduated from Corpus Christi College, Cambridge. He is a retired Colonel in the Royal Engineers, and saw most of his service in India, on the North West Frontier. He is a past president of the British Society of Dowsers.

Patrick Echlin graduated from University College, London in 1957, and is now senior assistant in the School of Botany of the University of Cambridge. He obtained a Ph.D. in medical microbiology at the University of Pennsylvania School of Medicine in 1961. His research interests include not only algae, but also the fine structure and development of pollen. He is a fellow of Clare Hall.

Patricia Wright read Psychology at University College, London, and there wrote a Ph.D. thesis on Programmed Learning. Currently she is researching into the problems surrounding various forms of written communication (prose, instructions for apparatus, tabular information, etc.) as a member of the Medical Research Council's scientific staff at the Applied Psychology Unit in Cambridge, and has published a number of papers on the psychology of language and the ergonomics of visually displayed information.

Michael John Morgan is Assistant in Research at the Psychological Laboratory, University of Cambridge. He was Assistant Professor, McGill University (Montreal) 1969–70. Research Fellow of Queens' College, Cambridge. Research Interests: Motivation and Learning in animals; the concepts of "left" and "right" in people; visual illusions.

The late **Sir Geoffrey Jefferson,** F.R.S., was Professor of Neurosurgery in the University of Manchester.

Joseph Needham, F.R.S., is Master of Gonville and Caius College, Cambridge, and was formerly Reader in Biochemistry in the University of Cambridge. He has been engaged since 1948 on "Science and Civilization in China", a comprehensive history of Chinese science, medicine, and technology, the sixth volume of which will shortly be published.

Arthur Bell read Archaeology and Anthropology, followed by Theology, in Cambridge, and then went to the College of the Resurrection, Mirfield. He now works as a priest and teacher in Wabasca (between the Peace and the Athabasca rivers in North Alberta) where 90% of the population are Cree Indians.

Walter Roberts studied at Cambridge and Harvard, and has won prizes for poetry, including the Seatonian and an Olympic medal. In recent years he has become involved in the philosophy of science and is a counsellor to graduate students. He has just written a play about the American Presidency.

I. J. Good, who designed the cover, is Professor of Statistics at the Virginia Polytechnic Institute. He was the general editor of *The scientist speculates* (1962), and the author of *Probability and the Weighing of Evidence* (1950) and *The Estimation of Probabilities* (1965), and over a hundred articles in mathematical, statistical, and other periodicals.

Christopher Clarke read Mathematics at Christ's College, Cambridge, and is now a research fellow of Jesus College. His main interest is Topological Relativity.

John Dobson teaches and researches into teaching methods for a computer services company. His other main interests are in everything that can be seen in the countryside.

Dr. Hooper though trained as a geneticist has been mainly concerned with the age of hedgerows and their importance as a wildlife habitat since he went to Monks Wood.

Dr. Way worked on the effects of herbicides on crop plants before going to Monks Wood, but has since been studying their effect on wild species, particularly on roadside verges and in aquatic habitats.

Dr. Pollard is an entomologist who, like Dr. Hooper and Dr. Way, works in the Toxic Chemicals and Wildlife Section at Monks Wood, where he is studying the importance of hedges as a habitat for invertebrates.

Dr. Perring is head of the Biological Records Centre where he is responsible for co-ordinating the collection of information on the distribution of all wild plants and animals which occur in the British Isles.

THEORIA to theory

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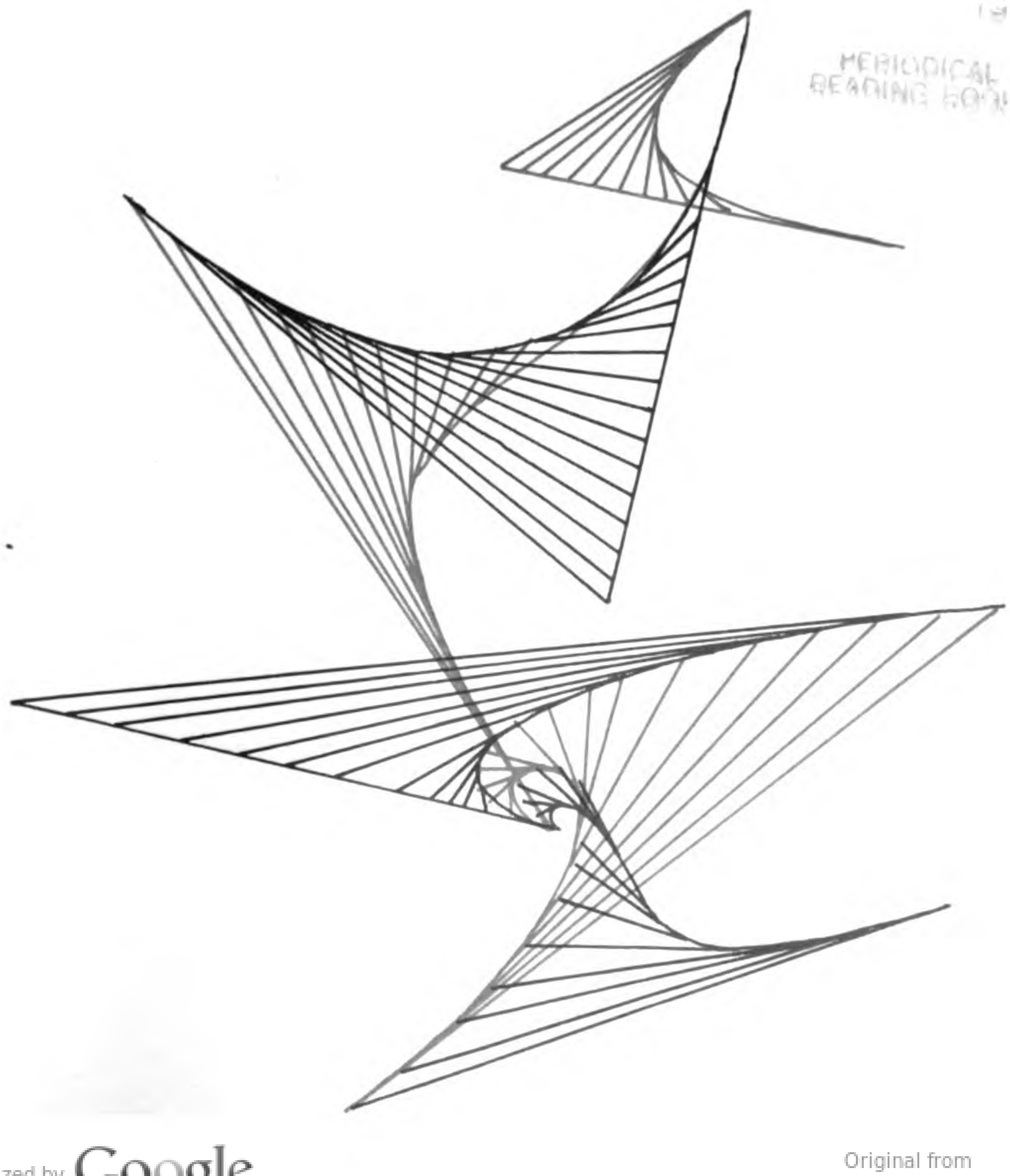

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Editorial

This number has a certain "in Cambridge", if not "in-group", look about it. It has been assembled during the postal strike; one or two expected pieces have not been able to reach us, and we have been dependent on co-operation—some of it generously given at short notice—from people with whom we have been able to be in personal contact. The last number was through the press and ready for distribution by the end of January—we had caught up on publication dates—but it was impounded by the strike.

An article appeared in *Nature*, (229, 5281, January 15th) which coincided, more or less, with the interview we published with Colonel Merrylees. This article seemed to give the *coup-de-grâce* to dowsing (water divining), and the following notes arise from the coincidence with our interview, and are also concerned with the clash to which the two pieces draw attention. For some of the "science hate", which is another of our topics, can be traced to the difficulty of getting sympathetic consideration for experimental evidence that doesn't fit into any of the established patterns.

In the first place, there is a good deal to be told about the circumstances under which the *Nature* article came to be written. The author, R. A. Foulkes, reports experiments conducted at two army establishments, and in both cases Colonel Merrylees had been in the preliminary discussion of the experiments but had not been responsible for their exact form nor for the way they were published. Colonel Merrylees is obliquely referred to in the *Nature* article and a photograph appears of him, dowsing. A letter from Merrylees, protesting about this treatment and about a serious misrepresentation of the results of the experiments has now been submitted to the Editor of *Nature* for publication.

Our concern is with the misrepresentation of the evidence, as a kind of distortion to which scientific method lays itself open in general.

At one establishment a series of experiments was conducted which were of the statistical sort that would immediately suggest themselves to the scientist in his ordinary role. They consisted in attempts to detect anti-personnel land mines, and to tell whether or not water was flowing in a buried 2″ polythene pipe. At the other establishment experiments much more within the normal run of dowsing practice were conducted. Merrylees had selected 10% of a large set of officer trainees as having good dowsing potential, and these were set to walk along a given line and stop as they dowsed the water. This was recorded by a corporal with a clip board.

The advice given by Merrylees for the first series of experiments (as indeed he reported in our last number) was that any dowsing experiment was unlikely to be successful unless it tested a skill the dowser knew he had and which he had established control over by practice. This advice was not reported in the *Nature* article. The experiments gave no results not to be expected on the chance hypothesis (except in the case of one isolated subject).

The experiments at the second establishment – those testing conventional dowsing – were successful in that all the subjects stopped at the same place, and indeed at the place that had previously been indicated by Merrylees*. We quote Foulkes' account of this experiment in full:

"Further tests were carried out at R.S.M.E. at Chatham. An experienced dowser undertook to train junior officers and judge their ability as dowsers. He took each of them over an alleged subterraneous waterflow when the student held one end of a forked rod and the dowser held the other. Students were then asked to dowse over what was alleged to be a second flow. Many officers were tested and 25% were found to be highly sensitive. These tests were later found to be invalid because a boring at the first trial site found no water at all".

Merrylees points out:

a. That he did not *train* the officers; he only selected them.

b. That the 25% were those who had shown some ability however slight. Only the 10% "good material" were used in the experiment.

c. That the boring never showed absence of water. Merrylees had asserted before boring began that water would be found

* When we described this arrangement to a scientific colleague recently, we felt bound to admit that the presence of the corporal constituted a blemish, since he could have conveyed the knowledge where to stop telepathically. The colleague said "But that would have been equally good from your point of view". When we denied this, and he saw we were really concerned to establish scientific distinctions in this, to him, "magic" area; he put his head in his hands and said "Oh God!" He saw a threat to the disappearance of a simple magic/non-magic distinction.

at the bottom of the chalk, which was at that point overlaid by a few hundred feet of clay. When the boring was half-way through the clay, however, the drill was needed elsewhere, and no more boring was ever done at that site.

To these comments we would add:

a. That the confluence of the dowsers' opinions was remarkable *in any case* (i.e. even if there had been shown to have been no water) and should have been reported.

b. That the boring at the first site would have been no evidence of what existed at the second site, even if Foulkes had reported it correctly.

c. In the quotation just given from Foulkes' account, the description of the tests which should come before "These tests . . ." is omitted. The reader tends not to notice this omission, and therefore not to expect an assessment of the results, because of the assertion which immediately follows, that, there being in fact no water, the experiment need not be considered any further.

It is hard to understand this treatment on Foulkes' part unless perhaps he had been misinformed about the sinking of the well, and was trying to tie up a case he was anyway quite sure was right as quickly as possible. Whatever the explanation, however, it leads us to a general question of some importance.

Foulkes' paper gives an impression of great thoroughness; indeed his statistical analysis of the anti-personnel mine results seems like using a sledge-hammer to crack a nut. That, perhaps, would not matter—it could even be justified as a protection against critics who might not be satisfied with a bald commonsense estimate that these experiments had failed. A more serious question, though, is whether commonsense has not failed at an earlier stage, when it was necessary to make an overall estimate of the problem. Thus the technically qualified reader is caused to feel that Foulkes is being, at best, pompous (see the *Washington Post* quotation below) and the non-technical reader to intuit that he is being blinded by science.

We certainly have to look into this question, since the elaborate presentation has had its effect. National papers published articles publicizing Foulkes; he was picked up by the B.B.C., and a lot of people heard – one way or another – of the definite position science now found it could take on the intriguing subject of dowsing.

As an example of a far flung reaction, one of us was presented on Vancouver Island with a cutting from the *Washington Post*, called "Dousing the Water Diviners". "London – With scholarly solemnity, the science magazine Nature devotes six pages of its current issue to an experiment, run by the British Army and Ministry of Defence, on dowsing, the art of finding buried objects or water with divining rods.

"The verdict: 'The results obtained by dowsing are no more than a series of guesses'."

The problem raised by widespread publicity of this sort is that it does a great deal to widen and harden the division between conventional, "sound", established knowledge and adventurous but way-out or fringe knowledge. This hardening process is always tending to produce degeneration on both sides, with the resulting sterility of the trivial on one side and the irresponsibly imaginative on the other (designated in an earlier editorial as "wowsky"). The "scholarly devotion" with its suggestion of finality is bound to divide the bulk of readers – both scientists and others – who have no specialized knowledge into two camps. One camp accepts the "result" – either with relief, or with regret at the passing of another bit of interesting folk lore. The other camp smells a rat, but doesn't know where to locate it, and is left waiting for an opportunity to hit back – either in an anti-rationalist manner, or simply against the scientific establishment.

If one looks more closely, the "scholarly devotion" of Foulkes becomes queerer and queerer. Whoever heard of a biologist or a physicist attempting to set up one series of experiments in a field where there is a vast literature of successful experience, and making generalizations from one series of negative results (supposing for the moment that the result had been negative)? Scientific practice is all against it. Recently everyone was interested by a report that certain worms had acquired the memories of predecessors which had been ground up and fed to them. Half a hundred laboratories set out to repeat the experiments, but none succeeded. They got together to publish their results, but were about as careful to draw no general conclusion from even so many negative cases as a newspaper would be to avoid assuming the guilt of an accused person under trial. And all this in a situation in which only *one* positive claim was in question.

Out of all the literature, Foulkes picks one survey conducted by Y. Rocard (*Le Signal du Sourcier*, Dunod, Paris) for comment. This survey was conducted from a quite conventional viewpoint, and Foulkes' comments on it seem fair. However, and to illustrate the inadvisability of allowing any one survey to stand for a whole field of research, we may mention a report which appeared the same week as Foulkes' paper. In this (*Parapsychology Review* 2, 1 January, 1971) Alvin Kaufman describes how – using equally conventional physical techniques – he has demonstrated a dowsing force on a dowsing rod which cannot be reproduced by the dowser himself in the absence of water (or indeed by any mechanism replacing the dowser's hands). These observations – incidentally – are in direct conflict with what in our interview we agreed with Merrylees it was reasonable to expect. It is extremely desirable to get further evidence on this question.

We have analysed the Foulkes paper in some detail and observed the way that work like it can increase the "Science Hate": what have we discovered that might help us to understand what has happened in this case, and might happen in others like it? (We need a more subtle analysis, of course, than one that merely says people either feel comfortable in the presence of phenomena like dowsing or else uncomfortable, and orient evidence in accord with their wishes).

Foulkes' experimenters seemed to have a very definite idea of what an experiment ought to be like. If we parodied their position as saying "scientific knowledge is what our experiments will discover" it would not be too unfair. Thus Merrylees' specifications of what he would consider a reasonable experiment were disregarded, in the main, and the assumption clearly was that, if dowsing effects existed, then they *must* be responsive to the "proper" experiment for that sort of thing. If you can detect water flow, then you can detect water flow in a polythene pipe, and if you can't do that, then you can't detect water, and that's that: no need for further experimentation. Of course, if a Merrylees were to say that polythene was a bad transmitter of dowsing waves, and please could he use glass pipes, every courtesy and help would be extended, because he would be bringing himself within the existing universe of discourse of fields of force. However, if he says that it is just his experience that he can detect water flows in chalk beds, but not in polythene pipes, people will behave exactly as though they had not heard what he was saying. Let him go further, and put forward the attitude and state of mind of the dowser as one thing he has found to be experimentally significant, and he will be thought to be deliberately obscurantist.

In fact, it is extremely plausible that the state of mind of the dowser should affect the success of his dowsing. There is no reason we know of to reject any part of the total system of dowser + dowsed object in an interaction of a quite unknown sort; and, rightly seen, we are imposing arbitrary constraints on what we shall accept as fact if we exclude states of mind of the dowser even though they may be partly under his control. The objection that this makes the phenomenon "subjective" is false. However, to go on from here would lead into two or three very fundamental questions in the philosophy of science which are a general preoccupation of this journal.

* * *

This quarter's cover design, like that of the previous issue, is generated by the motions of a number of points each moving with constant speed either towards a fixed point or towards the next moving point. The curves are traced by the points as they move, while the straight lines indicate the direction of motion at any instant. Simple rectilinear motions combined by a simple rule thus give rise to patterns of great complexity. Would any readers like to send us other possible cover designs of this kind?

Discussion: Action Space

Kathleen Russell talks to Ken Turner, Mary Turner, Alan Nisbet and Richard Harper of the Action Space team.

Kathleen Russell

We have heard about the work of Action Space. Could you tell us more about it?

Ken Turner

Before explaining what we are getting at and why, I feel the need to ask you a question in reply: why do you want to know how and why we work?

Kathleen Russell

Well, anything interests me where somebody is trying to create anything they choose to call an art form because I am very puzzled about what art is doing. In my own work I'm looking at the way ballets are made, what might be the rules for structuring a ballet. This involves all kinds of other problems – about what comes across in the ballet; what the structure is doing in it. Therefore any activity related to that interests me, in that it helps me to see what these specific kind of balletic structures are doing.

Ken Turner

Why I asked that question before we begin explaining, exposing ourselves, is because of the danger in looking at us from the point of view of the art world. This viewpoint we question, and in fact questioning is one of our basic tools. Everything that turns up and every idea, person, organization, has to be questioned, but the questioning is often not direct; it is implicit in our methods. We deal with fundamentally intuitive, non-intellectual processes. Going back now to why and how we started: beginning from the visual arts, and the organization that goes to propagating them, we can see how within the structure of disseminating these there is a repressive element. There always is a repressive element when groups of people get together in an organization.

Kathleen Russell

Can I just stop you a minute? You mean when groups of people get together for making art public or commercial, the very nature of the group which is there to do this becomes repressive?

Ken Turner

Yes, because essentially the artist is a revolutionary, he's free but disciplined within his own systems. When people are just observing, or looking at art in a very detached way, it becomes a product, it's 'worth so much money' prestigewise, and all the rest of it. Then there is a danger of getting away from the rawness of life, I say 'rawness' because it's something very terrifying – trying to understand the mystery. These people who don't understand want to do something about it, and the easiest path to follow is to fabricate art with sophistication. Now this brings about a claustrophobic situation for the development of the artist in a society. There's always a need for the artist to break away, and this is what's happening all the way through art or arts of all kinds; I mean there's this attempt to change a style or change a direction in search of truth. The style becomes the product, but the content is always the process. We aimed at finding different means of getting away from the repressive element and nearer to the process. I don't think the four founder members of Action Space came together saying 'O.K. this is it, this is the time when IT'S going to happen'. We could only see that parts were beginning to fit together in a new way; we had to feel intuitively that things were right; there's no grand plan to work to. It often happens by accident or by force of circumstances which I think is sometimes accidental.

Mary Turner

We took what we had, structures, pneumatic and rigid; techniques were developed in sound, movement and drama, and we created outlets for ourselves in parks, streets, and playgrounds. The work was an experiment in living as well as a striving to find an art relevant to a wider public.

Ken Turner

Yes, one can look round at the environment, for example of architecture; it's a kind of symbol of the repressive element in society, repressive because it is a dominating force within a society that comes about through a non-feeling, a non-understanding of people and their very ordinary actions, their very natural actions and desires to communicate. Once you've stopped this desire the whole concept of meaningful contact is lost. Organisation through bureaucracy, or economics, or architecture, I think, clearly shows that people are being pushed around very physically and placed very physically in situations which affect the spirit.

Kathleen Russell
And by the spirit you mean the raw level of contact with life?

Ken Turner
Yes. Architecture and systems are end products. To us the product really isn't important. It's the *process* that matters – the work proceeding. This is what we are *really* concerned with and engaged in a very total sense. What happens to the process's product is almost unimportant.

Kathleen Russell
So the artist is not thinking about what is going to be happening to the people who are looking at, or, in your case touching, the work of art? He himself is perhaps going on a spiritual venture as he's creating this thing, and he's using it for his own development? Then what is the person who looks at this thing? Is the artist concerned at that point? Or is he concerned just with his own venture?

Ken Turner
Well, here, with us, it began with looking at the existing structure of how the art was in fact used. We found that there was, as you know, an élite audience for a very élite product. If we say 'it's not the product which is important' then how does the process work on these people, and why shouldn't the process of art work on a much larger section of the public? And so we began looking away from the centre of the élite organization to these people who were being left out of something we felt was terribly important.

Mary Turner
We didn't really look for the people, we found them. We didn't like the art gallery world; we felt the need to work outside it. Outside it we found other people who weren't in the gallery world either, and they found us fairly violently. Out of this situation we continued working together, and it was from our and their need that the sort

of work we do has developed. The sort of work that requires initially physical response, so that people unselfconsciously involve themselves in sound, colour, form, touch, speech.

Kathleen Russell
Perhaps at this point, you could tell some of the things that you do in relation to what you have said about objects and people's response or involvement.

Mary Turner
People in our society have a particular and very materialistic way of using objects. It's the only way most people know how to use objects. Present them with an object, and they say 'how can this be marketed?' Quite suddenly, one just didn't want this sort of thing any more. We were prepared to work for free, to beg materials, because we needed to make a complete break. We've made objects. We've said 'use them; use them freely', and we've said this because of the pressure on anyone to produce objects people can buy and sell, can use as prestige things. Against this, I think, we concentrated mostly on the process – on letting other people into the process; not getting them to admire the product.

Kathleen Russell
So you're letting people into the process of making objects themselves, and then having this kind of non-commercial attachment to the objects?

Mary Turner
We like to have all objects fairly expendable, and this is the great advantage of working with inflatables. Those who badly treat them can easily repair them, and have to!

Kathleen Russell
Now I see why you have disposable objects: it makes commercial detachment easier.

Mary Turner
If we use wood we use cheap wood, replaceable in sections. It's 'for the use of', not for the keeping. You have got to do this, to get outside objects' commercial use.

Kathleen Russell
That makes excellent sense.

Ken Turner
The danger of the élite becoming interested means they bring in entrepreneurs who, if they write, will say 'Here's a new art form'. 'New styles, new forms, we must notice them': already you can see the Arts Council doing this. And yet for all this they can't recognize far enough ahead; its understandable, because the majority of them are non-practitioners in the new arts.

Mary Turner
Another thing we are trying to do is to turn upside down the statement which many modern artists have made in this century, that if you put anything into a gallery as an artist it is a work of art. The generally accepted view is that anything done by an artist that is picked out is a work of art. Now in a way we're reversing this. We are saying we can take art and put it where it isn't in an art situation. We're taking things and putting them where art isn't recognized, where the 'art' situation just is not, to the pain of people within the art world. People say 'you are no longer being artists because you're working in Wapping', – well, this is what they mean, put more subtly. They think 'what you're doing is no longer art because you're letting kids climb on it'. 'What you're doing is no longer art because we are not in on it'. 'Aren't you really doing social work?' They're not just being nasty. They are having to rethink their whole position. If you take stuff out and let it be broken up, let it be used, is it still viable as art?

Kathleen Russell
I do think at this stage I'd like a bit of description of some of the things you do.

Ken Turner
Let's start with the most complete form of structures that we've made so far, and explain how we use them, and how the public use them. I think we'll describe the evening events we did in Sloane Square. Richard, will you describe Sloane Square?

Richard Harper
We used structures with adults and children of all ages. The struc-

ture we used was one that had been developing or growing as a structure, a physical form. It was at a stage when it was designed to make possible a journey through tunnels and small structures.

Kathleen Russell
What was it made of?

Richard Harper
Sixteen thou P.V.C. (Polyvinylchloride). It's pneumatic, an air structure, of different coloured P.V.C., with different light colours and luminosities throughout.

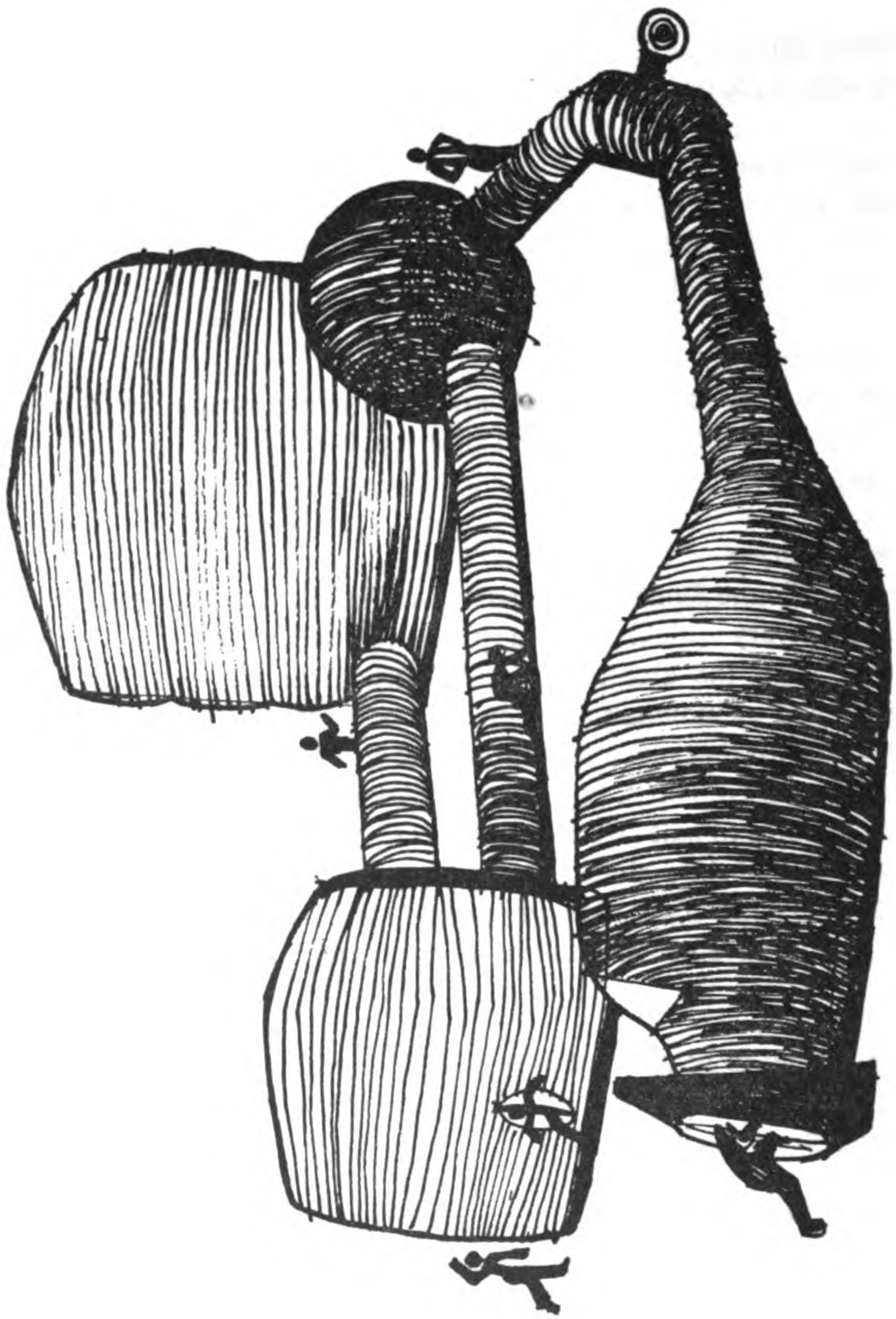
Kathleen Russell
An air structure means that you are actually having air blown into it to keep it in place, and you can go through it? You and the air are in it together?

Richard Harper
Yes. Now Sloane Square is virtually a traffic island. We're interested in coming very quickly into a place, almost by surprise. We're different from the architecture. The structures are very flexible, portable and demountable. They can be partially destroyed – it doesn't cost all that much to put together P.V.C., it's fairly inexpensive, and easily repaired. It just needs blowing up and it takes about twenty minutes to half an hour to erect. The erection of the structure becomes part of the activity. Immediately we arrive, it's like invaders coming in. Is it a film? Are we going to dig up the pavements, or blow up the pavements, or have a fairground? So interest begins.

Mary Turner
People offered to help. Passers-by said 'I have half an hour to spare, can I help you put this thing up?' Some stayed on to work all evening, we never knew their names.

Kathleen Russell
Do you invite people to have a go? Going through or climbing into it?

Ken Turner
Yes. You begin to build up a crowd and you can almost ritualize the assembling of the structure and the blowing of it up. People



Entering and Leaving an Inflatable.

enjoy watching this happen – it's a bit like theatre you see. We feel it's very essential to be identified by wearing similar clothes while working as a group. But people don't feel any barrier, they feel quite free immediately to join in. It's quite amazing how free they feel.

Mary Turner
We involve people who come in and say 'What is it?' and I'd say to them 'What do you think it is?' and some of them would say 'Well, it's for advertising', or 'you're fair people', or 'air pollution', or 'it's something to do with modern sculpture'. Some actually say this and then I think 'Ah, that's because they've been looking at the magazines'.

Ken Turner
But what's interesting in Sloane Square is the great mixture of people. We were picking up people who were passing through from Turkey, or China, or Stepney, or Walthamstow, or locally in Chelsea. They took their shoes off to go in.

Mary Turner
Standing at the entrance was an interesting job because there you have to explain in some way what's happening, anyway you like, make it perhaps ambiguous or joking or fun, like a fairground person. You have to keep it on a light plane, because there's some kind of terror in people, who say 'Well, what is it?' 'What is going to happen to us when we go in there?'

Alan Nisbet
As it's unexpected it's quite easy to see how people could be apprehensive about it, but what amazes me was that there were so many people who weren't at all apprehensive, threw off their shoes and dived in.

Mary Turner
Also we had sound going on; we had tapes made by Richard and Ray and instruments inside, live instruments with people playing them intermittently, and simple instruments that people coming in could join in with playing, so you had a background tape and then sound, live sound, inside. Sometimes people played badly and sometimes it was very good; sometimes a lot of outside people were playing, sometimes it was only us, and then people found they

could make their playing more effective by going round to the sound van and playing in there, so that their noise was amplified to the people inside the air structure. We had our background support of groups of little boys that came from the council flats round the corner, always very quick. We meet the same groups of little boys wherever we go. There's something going on and it's free. Also a remarkable gang came armed with various weapons. They went through the air structure, but they played the games inside too roughly and knocked one of themselves out and they disappeared from the scene.

Kathleen Russell
Do you mean that they invented games inside the structures? What kind of games?

Alan Nisbet
Well, I was inside. Initially my function seemed to be to take people in who didn't want to go in by themselves. First of all there was a big split between the ones who hurled themselves in and the others who very often were aching to go in, young kids, as well as adults.

Mary Turner
They were frightened they might be kicked.

Alan Nisbet
Very often the very young kids were scared of the whole very scary uncertain business, but I came across one or two adults who had to be taken in, who were itching to go in, and several times when I invited them to go in, and they were just about to, they said 'No', and they held back, so I'd go through probably with someone else, with some kid or someone, and when I'd come out they'd still be there, terribly excited and itching to go in, you know, trying to build up enough courage to go in.

Ken Turner
You're on your own going through the tunnel although you know somebody's in front. Perhaps you've got your nose right on their backside practically and there's somebody coming behind and you've got to keep moving. If you stop, you are persuaded to go further on, and then there are various elbows you come through

and in these elbows you get a change of colour, and a change of direction and fresh air coming in, and at the first elbow you come to you have to make a decision whether to go in one direction or another. You go through these tubes, and you can either go into a white 8 ft. cube or into a sphere which is multi-coloured, an 8 ft. to 10 ft. sphere, and you get a completely different spatial experience inside those different spaces, and psychologically between people the feelings are different from what they would be if you went into a brick building, a stable construction of that size. It's in constant movement, which is one of the sensations; very important – not only are you moving but the whole structure is moving.

Alan Nisbet
And you're moving on your knees together. You go into the white house and you sit down for rest and you may be alone, or you may come into somebody's stomach or get into a very funny position with someone.

Kathleen Russell
Is it something that you as an artist think of before you set up your structure? It's hard to know whether you set it up with a definite effect in mind or whether the effect is something that you discover as you go along – which can perhaps be used in a new situation.

Richard Harper
Yes, this is exactly the artistic process but carried out by a group. We didn't design the structure from A-Z. The structure itself is being built by different people for different reasons. What's very important is that it is growing and it has to grow with the participation. Every structure that we've made is made because something has happened with people, not just only within our group, so that it has to be stronger or bigger or more varied.

Mary Turner
We started building tubes because after Richard had built the air house, with colour sensations as he wanted, we found that for people to be able to use it it was necessary to approach it through a smaller space experience. After going through the tunnel in Sloane Square, people came out again into a great big space, but they were inside this air house, and in a new world.

Kathleen Russell
By having a small tunnel to go into a long space are you doing more than just creating contrasts (like the common ballet device of getting some to bend low while others jump, to make the jump look higher)? Are you making people go into unusual positions so that they feel differently at the end? Are you doing something different, like being initiated, so that you can look at the world in a different way?

Alan Nisbet
Before we lose the thread of your earlier question about what happens, I'll give my impressions of what I've done, or what I've come across. Sometimes when you go in, having crawled through the tubes, you arrive in the big airhouse. There's much more space in which to do something, and to develop something which you choose. Now it would be possible to organize something inside, and music is frequently organized, but sometimes I've gone through and I've found nothing has been going on except that sound has been coming in from outside. And I think 'let's make something happen', and on one occasion there was a big bouncer balloon, so somehow a game was initiated to keep the balloon off the floor, and I tried to urge on everybody the importance of keeping the balloon up, keeping it off the floor, just trying to build up a great big wild thing.

Kathleen Russell
And you did this partly by the tone of voice that you used?

Alan Nisbet
Yes. I was shouting, making myself hoarse, and quite a number of people joined in. There were a couple of people approximately my build. They looked rather like young agency executives to me. They were involved in the game but at the same time totally in their own world, totally preoccupied with the game which had evolved. I think it was at that point that I saw this elderly city gentleman who was sitting down, leaning back against the wall of the air house. I was concerned with trying to involve him much more physically. I felt it was necessary for everyone to be seen to be involved, so I said 'Come on man, get up there, get involved', but he said he was quite happy, 'it's all right, I'm quite happy', and I could see that he really was, because his face was smiling. All the

time when one is working positively in Action Space situations, or anything of a participatory nature like this, one is discovering something, and at that moment I discovered that there were obviously many levels of participation in other people. What I found it necessary to do to involve myself wouldn't necessarily be the case with other people. If I was ever sceptical about saying subsequently that something wasn't working in Action Space, that an event or a programme wasn't functioning properly because it didn't look as if it was, I remembered that this bloke and several other people like him were quite obviously having their own quiet involvement, and being totally wrapped up in it.

Kathleen Russell
This is like the man sitting in a concert hall listening to music; he's now sitting *in* the music.

Alan Nisbet
It could well be something like that. There was I expecting him to react like I might react. For instance, on one occasion I found myself in the air house and decided to develop something. After some preliminary work I gradually became aware of becoming oppressed by the others – they were against me. I seemed to remember that I was very thick and stupid and that I was suspicious of what was going on around me. People seemed to be dancing around me and there seemed to be a lot of long haired nits doing stupid things, and I took up a position against this, and I started questioning them, and I started being irritated by them, being irritated by all their student nonsense, and I began accusing them and trying to find out who they were. There was an older one who in fact wasn't anything to do with Action Space, possibly an executive type, anyway I didn't recognize who it was, and I accused him of being a tutor, and all the time my voice was getting more rancorous and was getting more and more indecipherable and I was getting more screaming, except that I was getting more and more hoarse, so I couldn't scream, and while I was doing this I found that I was getting more tense and I was getting curled up into a little ball, still trying to scream and hurl my abuse at these people who somehow seemed to have got the better of me – they had won. And I was reduced into total silence in a little foetus hate-ball on the floor. While I was on my feet all that I really noticed was that people

were going round, doing some sort of dance. When I hit the ground my eyes were totally closed and it was a long time before I could do anything, a long time, and then gradually something motivated me to twitch, and these twitchings got more and more convulsive, until I became almost epileptic, and I was aware that one or two people were rather scared by this, to the extent that I felt 'well, I mustn't go too far'. I noted that people were getting away from me, that I was trying to convulse out of what I had been, and eventually I managed it. Very gradually and painfully I managed to get up and straighten up. By this time, it was getting near to the end of that evening's session, and everyone had begun clearing up while I was trying to stretch up, trying to breathe – that's another thing I remember. I was trying to breathe air, to breathe fresh air, and while I was trying to breathe I was trying to get sort of reborn – I was vaguely aware that people were clearing up, deflating – and I felt 'well, I could go on and develop this, do some more with this, but there isn't time', and gradually I had to deflate my energy. But it was fresh energy, clean new energy full of relief because I'd got to a point far enough to *feel* reborn. In retrospect it is this sort of experience with its associated dancing, chanting and emotional after effects which makes me feel these events are strongly ritualistic.

Ken Turner
I think this is what does happen when we work outside in other areas, and perhaps without structures, where the need is to draw attention to different levels of experience. To do that you have to do it symbolically: you have to begin somewhere, beginning by a kind of initiation ceremony. This is the ideal type of ritual, although I think we never consciously or selfconsciously thought 'now we will do rituals'. Then the other week we vaguely thought about it, but we were really concerned with a very physical thing in the beginning, a sort of moving in space, or moving all the sensory faculties in extending ourselves in a story, or developing it. Roberta, who is working with us now, has been experimenting with us and telling stories and then acting them out or extending the stories; sort of going on from where Alan left off. This hasn't worked as well as we hoped. There's still a disjointed arbitrariness about 'O.K., we'll have a story'. It's a good idea theoretically, but it hasn't actually worked organically, so we're beginning to think about ritual as a performance to establish a position from which we can then

move forward. You know you're already through the curtain into an ambiguous world; we've to go through the surface of appearance, natural appearance, and arrive at a starting point where things are uncertain and irrational. To do that you need some kind of push, lead or guidance, and I think we are doing it with a lot of people by simply making our structures and using them in a place like Sloane Square. We used them three or four consecutive Saturdays, so that people could come back after the first experience; come back and develop other things that they wanted to develop. The structures themselves are part of the initiation business. People have to go into something and they have to take their shoes off. They're already in a different position physically. They meet other people in different positions, so all this is a kind of ritual or initiation; and then it's developed, and developed very freely. I think you've got to have rituals which are experimental in a very personal way. We go into play sites where it is impossible to use some parts of the equipment we have like the air structure. It is then that we develop the idea-structure in combination with movement and sound. The structure is the form and shape of these things. Through the form and shape we show an awareness of the ambiguities which lie below the surface.

Mary Turner
Ambiguity makes you question ordinary roles and environment. When people respond to these ambiguous situations, they find the situations are 'open', they can go on developing further possibilities in them, and making further responses beyond those already expressed, using parts of themselves they haven't hitherto used.

Kathleen Russell
Are you putting people into the frame of mind they get into before they start to create something?

Ken Turner
The crazy structures throw people out of their ordinary ideas, and give them a jolt out of the 'normal'.

Kathleen Russell
I don't believe there can be any art without structure, and physical structures help people to organize mental states.

Ken Turner
I see 'reality' as the inner structure of states of mind. But many people try and find their bearings in conventional ways, looking for recognized characters, not for the inner life under an apparently chaotic surface. So they don't see the inner structure in our happenings. But by using actual physical structures, and inviting people to participate we involve them in an activity with us.

Mary Turner
The people who go through movements in these structures may not be able to take symbolic experience in ballet, still less themselves do ballet movements. We are working mostly with people who don't go in for the arts, and who start from doing things physically.

Ken Turner
Their approach is primitive, in a deep sense of primitive. The tactile approach gives them more sensibility than they would get just from watching and listening. So what we do is designed for physical participation. You can't get much from Action Space by just looking at it; it is meant to be joined in. And I daresay you haven't got all that much of an idea of it from hearing us talk.

Kathleen Russell
At any rate you have made me want to arrange with our town to have you up.*

* Further information about Action Space can be obtained from "Action Space" 89C Fitzjohn's Avenue, London, N.W.3.

Prototypic Organisms IV: The Nemertines

E. N. Willmer

No one now questions the belief that man, as a primate, is related to ape-like creatures; nor is it questioned that the latter are related to other mammals, nor that mammals are descended from reptiles, reptiles from amphibia, and amphibia from fish. The exact line of descent may be doubtful (Fig. 1) and the difficulties of determining its precise course are very great, but the general uniformity of plan that characterizes the organization of the vertebrate body remains undisputed. Moreover, it is not very difficult to see how this basic plan has become progressively modified in various ways by the natural selection of those forms that are better adapted to life in particular ecological situations. When, however, the search for human ancestry is directed further back than the vertebrates, there is immediately a much greater uncertainty. The origin of fish remains obscure. The cyclostomes, i.e. hagfishes and lampreys of our streams, are certainly primitive, though the living representatives of these groups also have many degenerate characters, probably caused by their parasitic habits. The hagfishes and the lampreys differ from each other in several fundamental ways and probably had separate origins. Although they are certainly primitive in their main features, they still may not represent the earliest types of fish. The fossil record shows that some of the earliest fishes were heavily armoured with superficial bony plates, yet the elasmobranchs (dogfishes, sharks etc.), which are also primitive in many ways, have no bones but only cartilage. Furthermore, when a search is made for the organisms from which fish (whether cyclostomes, elasmobranchs, or bony fish) and hence the whole vertebrate stock originated there is an extraordinary hiatus.

The Cephalochordates (i.e. *Amphioxus* – the lancelet) (see Fig. 1) the Urochordates (e.g. Tunicates and Sea-squirts) and the Hemichordates (e.g. *Balanoglossus*) certainly have some features which relate them to early vertebrates, but it is unlikely that any of them are on the direct line of descent. In any case their origins and affinities are also shrouded in mystery.

Thus it must be admitted that the search for some animal that could reasonably be called a connecting link in the evolution of vertebrates from invertebrates has not been very successful: there is nothing in this situation to compare with *Peripatus*, the caterpillar-like animal that may be said to link the segmental worms (annelids) to the arthropods and particularly the insects. *Amphioxus* and larval tunicates (i.e. the free-swimming juvenile forms before they settle on the sea bottom and become sedentary sea-squirts) are probably not far removed from the organisms that were on the direct line, but neither of them are entirely satisfactory as prototypes or links. Of course, there is no reason why the actual intermediate forms should ever be found, because they would have become modified and would now either appear as vertebrates, or they would have been superceded by their more successful relatives and have become extinct.

When the evolutionary story is unfolded from the opposite direction, i.e. instead of tracing history backwards, examining the evolution of animals as they may have progressed from the relatively simple to the more complex, it is not difficult to imagine that some form of small and probably floating colonial organism, resembling *Volvox* (the hollow spherical organism often found in ponds) or some simple embryonic blastula,* developed from the unicellular protozoa by adhesion of cellular units essentially of protozoan type. There may be conflicting views as to the exact mechanism by which this primitive colonialism was achieved but multi-cellular colonies almost certainly evolved from unicellular organisms. Similarly, the flattening of such a blastula, after sinking to the bottom, and its subsequent adaptation to a creeping rather than a floating existence is not difficult to visualise; nor is the colonization of the cavity within the blastula (i.e. the blastocoel) by invading cells to give rise to a solid rather than a hollow organism. Creeping necessitates the development, sooner or later, of an anterior end and the establishment of antero-posterior, dorso-ventral axes, and of bilateral symmetry. In this way, organisms not unlike existing free-living flatworms (in particular the rhabdocoels) would be a natural development (see Fig. 1).

These creeping worms, as they became better organized, would be faced with feeding problems; some might have adopted directly ingestive methods, others the production of currents by the beating of cilia on their surface to waft particles into the mouth. Probably some sort of alimentary canal would facilitate digestion and the

* See Glossary.

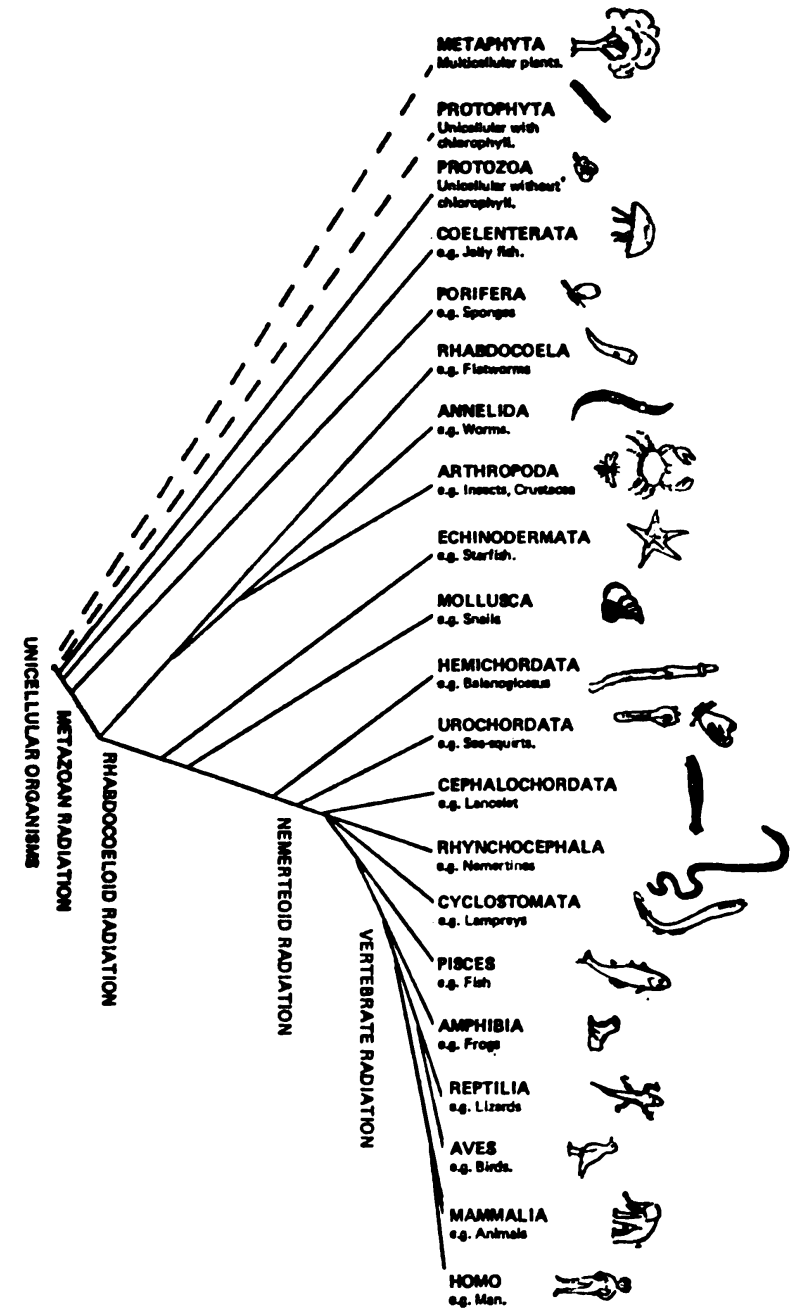
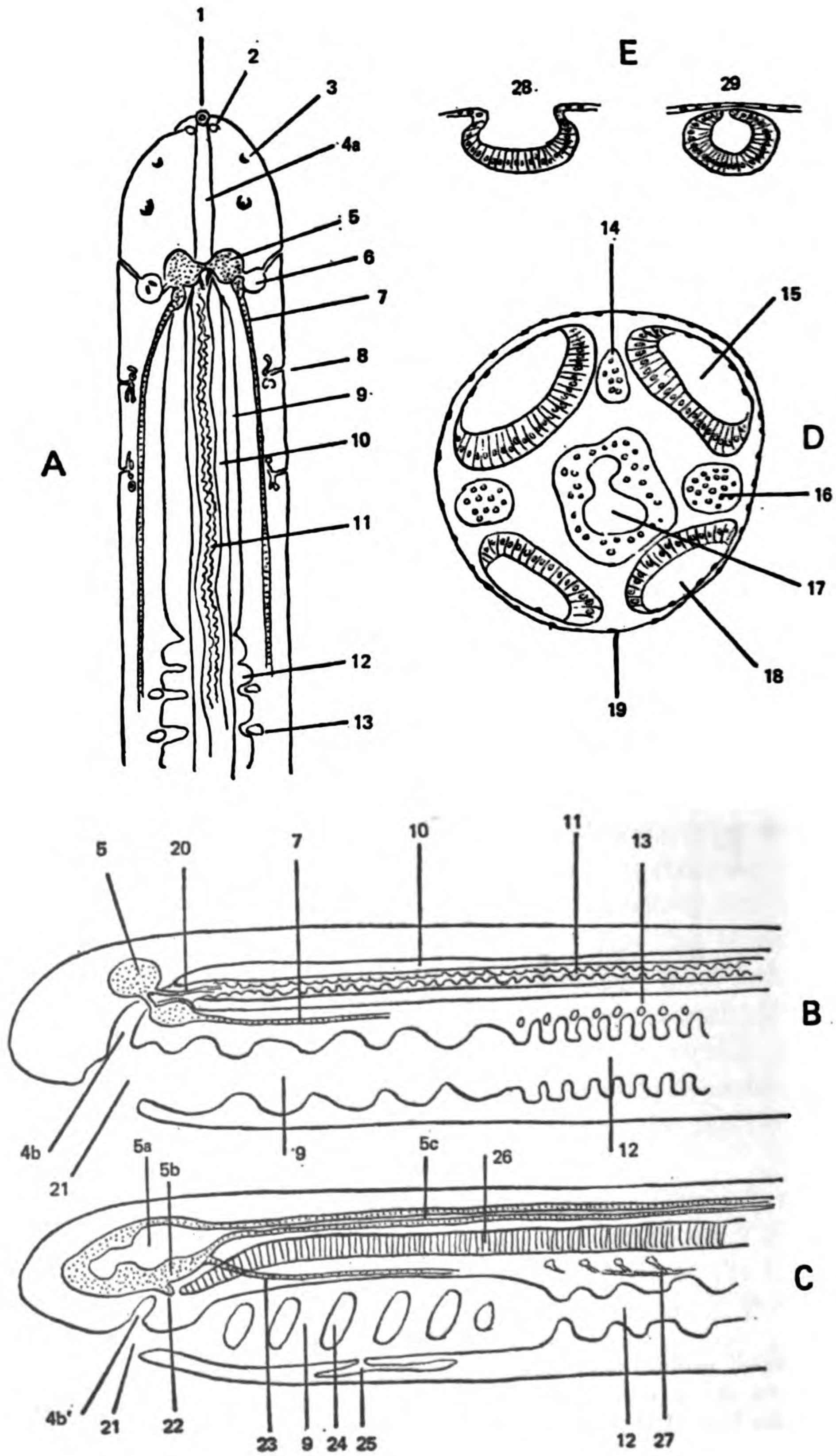


Fig. 1

A suggested evolutionary tree, illustrating the progression from unicellular organisms many millions of years ago to some of the main groups of organisms that exist at the present day.


A
B
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1
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Fig. 2

From Nemertines to Vertebrates

A. Diagram of anterior end of a generalized nemertine. Dorsal view.
B. Diagram of anterior end of a generalized nemertine. Lateral view.
C. Diagram of anterior end of a generalized early vertebrate. Lateral view.
D. Diagram of section through embryo of a nemertine, showing "amnia".
E. Diagram of two stages in the development of the neutral tube of a vertebrate.
1. Opening of rhynchodaeum through which the proboscis is everted. Primitive position at anterior end.
2. Frontal sensory organ.
3. "Eye-spot".
4a. Rhynchodaeum, opening anteriorly, for eversion of proboscis.
4b. Rhynchodaeum, opening into buccal cavity.
4b. Rathke's pouch. Origin of anterior pituitary.
5. Cephalic ganglia.
5a. Brain vesicle of vertebrate.
5b. Hypothalamic part of brain (autonomic "centre").
5c. Tubular nerve cord.
6. Cephalic organ.
7. Lateral nerve cord.
8. Nephridium (cf. 27) or excretory tubule.
9. Pharynx (pouched in B; cf. 24).
10. Rhynchocoel (closed space surrounding the proboscis).
11. Proboscis (cf. 26).
12. Intestine.
13. Segmental gonads or sex glands (cf. 27).
14. Proboscis rudiment.
15. Cephalic "placode" with "amnion".
16. Rudiment of cephalic organ.
17. Gut.
18. Dorsal "placode" with "amnion".
19. Larval epithelium.
20. Nerve to proboscis (cf. 22).
21. Mouth.
22. Posterior pituitary.
23. Tenth cranial nerve (vagus).
24. Gill slit.
25. Origin of thyroid gland.
26. Notochord.
27. Pronephric coelomoducts.
28. Transverse section of neural groove.
29. Formation of neural tube (transverse section).

removal of unwanted or undigested material. The members of one group of flatworms, the Nemertines, have adopted a remarkable system of ejecting from their anterior end a long finger-like process or proboscis (Fig. 2. 11) for entangling and poisoning the prey before swallowing it and digesting it. Mechanically the proboscis resembles a glove finger, which may either project as a hollow cylinder or be withdrawn, outside-in, into the "palm" of the glove. In Fig. 2 it is depicted in the latter state.

In such worm-like creatures, repetitive duplication of organs (e.g. sex glands) (Fig. 2. 13) may have led to a fairly regular serialization and ultimately to the regular and repetitive (metameric) segmentation as it occurs in the annelid worms (e.g. the earthworm or the swimming polychaetes of the sea-shore). In such animals segmentation assists in the swimming and creeping movements by providing the right degree of rigidity and flexibility. Such metameric segmentation has been handed on in modified form to the arthropods, e.g. the crustacea and the insects. On the other hand, the gap between such metamerically segmented organisms and the most primitive vertebrates seems to be unbridged, though the early vertebrates show definite serialization (see Fig. 2. 27) and some degree of segmentation.

At this point, where it is necessary to search for the most likely path which led from flatworms to vertebrates, i.e. to bridge this yawning hiatus, it is sensible to pause and to ask ourselves what features we are looking for in an invertebrate organism that would entitle that organism to be considered as a vertebrate ancestor.

Features which seem to be basic to vertebrate organization and which are thus likely to have precursors in a genuine ancestor of the vertebrates include the following: —

1. A notochord (Fig. 2, C, 26) and the potentiality for the formation of an axial skeleton of either cartilage or bone.
2. A dorsal nerve cord (Fig. 2, C, 5a-c) formed by longitudinal infolding of the surface epithelium (ectoderm) and subsequent closure to form a neural tube (Fig. 2 E, 28, 29).
3. An organ which could give rise to the vertebrate eye with separate origins for lens, retina and sclera (eye-ball).
4. Incomplete segmentation of at least the posterior part of the body, providing for lateral swimming movements and involving muscle segments or somites.
5. Tissues which could give rise to the various endocrine glands

e.g. the anterior pituitary, posterior pituitary, thyroid, thymus, pineal gland, and adrenal glands, and also to the pancreas, kidneys and (or) coelomoduct tubules.

6. Gill arches and gill clefts (Fig. 2, C, 24).
7. A main body-cavity (coelom) and a separate blood system with blood cells and haemoglobin.

This is a formidable array of requirements, but it represents only those features that are actually present in the lowest of existing vertebrates. Many of them are present in Cephalochordates (e.g. dorsal nerve, somites, gill slits) and a few in Urochordates (e.g. gill slits, segmental tail and lateral swimming movements) and in Hemichordates (dorsal nerve, gill slits and notochord(?)). Thus these three groups of organisms clearly have features akin to those that must have graced the vertebrate ancestors, but none of them seems to be very close to the direct line of descent, and each presents major difficulties or deficiencies when considered in this connexion.

The Dutch embryologist, Hubrecht, probably came much nearer to the solution of the problem than later zoologists have ever realized when, in 1883, he suggested that certain Nemertine worms (Fig. 2, A & B) possessed features that could reasonably be expected to become modified by natural selection in such ways as to allow these organisms to qualify for the position of vertebrate ancestor.

Since these creatures, which are sometimes called bootlace worms, are hardly known even to zoologists (some standard text-books do not even mention them) some description of their salient features may not be out of place. These features will be presented in such a way as to show how they could be relevant to the origin of vertebrates.

Nemertines constitute a heterogeneous group of worm-like creatures inhabiting a wide variety of ecological environments. Some are free-swimming in the ocean, some are littoral, others estuarine; some inhabit fresh waters and others are terrestrial, provided that adequate moisture is available. There is thus considerable variety of form and a high degree of flexibility in the patterns developed. Some are even parasitic. Many of the littoral Nemertines bury themselves partly in the mud and, as already mentioned, catch their prey by everting a very long proboscis from their anterior end. This proboscis is normally housed in a cavity that runs from the anterior end most of the way down the body (Fig. 2, A, B, 10, 11). It is a most extraordinary construction and apparently such a specialized object that it has deflected the interest of zoologists away from the Nemertines as organisms of any evolutionary significance. There has, however, been the one notable exception: Hubrecht conceived the idea that this proboscis, so far from being a mere eccentricity, was in fact a key structure and gave a clue to the age-old problem of the origin of the vertebrate notochord (compare Figs. 2, B & C). Both notochord and proboscis develop embryologically from a long column of cells just dorsal to the gut. If, for some reason, the proboscis became functionless or redundant, as might happen if the worms adopted a more active swimming mode of life with different methods of feeding, then it could still develop in the embryo but remain as a column of cells (cf. the notochord of *Amphioxus*), or go on to form the essentially tubular structure that it eventually becomes (cf. the notochord of Elasmobranchs). Accumulation of mucous substances in these structures – and the nemertine proboscis normally secretes large quantities of these – could convert these structures into semi-rigid rods which could become useful in providing the necessary semi-rigidity for the type of side to side swimming movements that are found in the Cephalochordates (e.g. *Amphioxus*) and in fish. Some Nemertines, e.g. *Cerebratulus*, do actually swim, though they still have a proboscis and the swimming movements are snake-like except that the waves oscillate in the vertical plane. Nevertheless, *Cerebratulus* is interesting in another way, because it has a pharynx (Fig. 2, 9) that is well supplied with blood vessels and it can rhythmically inflate and deflate this pharynx with sea-water as an aid to respiratory exchange. In some near relatives, the pharynx is also provided with lateral pouches, and in others the blood contains cells as it does in vertebrates including some that contain haemoglobin. Thus it is not difficult to imagine that a nemertine could gain mobility, with loss of a functional proboscis, and gain a pharynx with pouches and a rich blood supply which would assist in solving its consequential respiratory problems. Further, such a pouched pharynx could rather easily become converted into a pharynx with clefts (compare Figs. 2, B and C), so that gills were formed with all the advantages ensuing as the result of the through currents of water. Thus the obsolescence of the proboscis combined with the development of motility could also spark off the development of a gill-arch system. If a creeping worm were to adopt a free-swimming existence it would very soon require better sense organs, particularly at the anterior end in order to inform it about its environment and warn it of approaching obstacles. This could lead to the development of eyes and of a much improved neural system for integrating this new sensory information into whatever motor system was providing the motive power. The existing nervous system, as seen in Nemertines (Fig. 2, A and B, 5, 7), is mainly concerned with chemoreceptors and the co-ordination of relatively slow creeping movements and the digestive mechanism. This system alone would be quite inadequate.

Now the vertebrate nervous system is peculiarly, and rather unaccountably, divided into two parts, the "autonomic nervous system" and "the central or somatic nervous system". They develop differently and they function differently. Bodily movement is mainly controlled by the somatic system, while the movements connected with feeding, and with the digestive and blood systems are mainly controlled by the autonomic system. There is thus no inherent difficulty in supposing that the central nervous system of vertebrates is in fact a new development grafted on to the "autonomic" system at a comparatively late stage in evolution, i.e. after the "nemertine stage" and at the time when bodily movement and free-swimming in a directional manner were being developed. Thus the nervous system as seen in Nemertines could well correspond to what has become mainly the autonomic system of vertebrates, while the development of the somatic nervous system resulted from the creatures developing a free-swimming life.

A peculiarly interesting feature of this idea is that the Nemertines show a unique feature in their embryonic development. The epidermis (ectoderm) of the early embryo invaginates in a series of hollows whose sides then fold over so that the contained cavities, sometimes called amnia, may become sealed off from the outside world (see Fig. 2, D, 15, 18). This is essentially what must have been the mechanism which gave rise to the neural tube, as it now forms in all vertebrates (see Fig. 2, E, 28, 29). Thus, in these worms and in these alone, we find one of the necessary features for developing a neural tube on the lines that this structure develops embryologically in the vertebrates. There is also a very variable, and elaborate paired organ, the cephalic organ, on the side of the head of Nemertines (Fig. 2, A, 6), especially of those that are terrestrial or littoral in their distribution. This organ has histological features that suggest its possible conversion into an eye of the vertebrate type, i.e. with separate lens and layered retinal organization. The anterior end of some Nemertines also possesses "eyespots" (Fig. 2, A, 3) some of which have a structure almost identical with that of the "pineal" eye of a lamprey.

The proboscis is normally ejected forcibly by increasing the pressure in its surrounding cavity. It is a tissue that is very richly supplied with nerves, both sensory and motor (Fig. 2, B, 20), and in some species it is retracted by means of a special muscle attached between its posterior end and the posterior and dorsal wall of its containing cavity. The nerves originate in the cephalic ganglia near the point of attachment of the proboscis. In view of the previous suggestions with regard to the proboscis, it is pertinent to enquire what would be likely to have happened to the proboscis nerves if the proboscis became functionless. Alternatively, if one is looking for possible fore-runners of characteristic vertebrate structures it is pertinent to ask why the posterior lobe of the pituitary gland that secretes the hormones, oxytocin and vasopressin, is not histologically glandular or like the anterior lobe, but is evidently composed of modified nerve fibres which apparently go nowhere and yet produce these "neurosecretory" hormones from their endings. Is it mere coincidence that the retractor muscle of the nemertine proboscis contracts vigorously to oxytocin and not to other muscle stimulants, or that "neurosecretory granules" can be traced all the way from the cephalic ganglia to the retractor muscle? Is the posterior pituitary then perhaps the remnant of the proboscis nerves?

In some Nemertines the proboscis cavity opens at the anterior end of the animal and the structure is everted through this orifice (Fig. 2, A, 1 and 4a). If such a proboscis became functionless and acted as a notochord, the latter would presumably extend to the anterior end of the animal as it does in *Amphioxus*. In other Nemertines the proboscis has its opening into the dorsal surface of the buccal cavity (Fig. 2, B, 4b) so that the proboscis is everted through the mouth. If such a proboscis became converted into a notochord, the latter would end just posterior to the mouth as it does in most vertebrates (Fig. 2, C, 26) and a pocket would be left on the dorsal surface of the mouth (Fig. 2, C, 4b). All vertebrates have such a "Rathke's pocket", and the anterior lobe of the pituitary develops from it. It is therefore probably not just coincidence that the lining epithelium of the mouth of *Lineus* (a common Nemertine) contains at least six different types of epithelial cell whose staining reactions are very similar to those of the cells of the anterior pituitary – a tissue peculiarly diverse in the types of its cells.

Thus, if the mouth and pharynx of the Nemertines can be visualized as providing possible precursors of the anterior pituitary, and the gill system respectively, it should not surprise us to find that there are cells present within the pharyngeal epithelium, that, like the chloride-secreting cells of the gills of fishes, and the oxyntic or acid-secreting cells of the stomach, are very rich in the special enzyme, carbonic anhydrase, which is concerned in both these secretory processes. Nor should we be surprised that iodine is picked up very avidly by the pharyngeal membrane because in the vertebrates the cells of the thyroid gland originate from the floor of the pharynx (Fig. 2, C, 25), and they produce the iodine containing hormone thyroxin.

All these observations suggest that the Nemertines should be resuscitated from the limbo to which they have been consigned by zoologists and should be re-investigated in greater detail as organisms not only of exceptional interest in themselves but also because of their special relevance to the origin of Enteropneusts, Urochordates, Cephalochordates and Vertebrates (Fig. 1). They are indeed prototypic organisms of the highest importance and should no longer be treated as aberrant curiosities of Nature.

GLOSSARY

Amphioxus	Small fish-like creature, with notochord, gills, dorsal nerve cord, segmental muscles.
Balanoglossus	Worm-like creature, living half-buried in sand. It has gill slits, a dorsal nerve cord, and a structure resembling a notochord.
Blastula	Hollow sphere of cells that occurs as a stage in the embryonic life of a very large number of organisms.
Cilia	Minute protoplasmic hair-like processes on the surface of certain cells. They beat in rhythm with an effective stiff stroke in one direction and a recovery stroke in the other. In the latter the cilia are bent.
Coelomoducts	Tubes which connect the main body-cavity (coelom) to the outside world. Their origin in vertebrates is problematical.
Endocrine	Term applied to glands producing internal secretions or hormones.
Invagination	A folding inwards.

Nerve cord	A strand of nerve cells and tissues providing the main nervous system. In vertebrates it is dorsal, in most invertebrates it is either ventral or exists as two lateral cords.
Notochord	A gelatinous rod running most of the way along the body in vertebrate embryos. It later becomes enclosed within the vertebrae.
Oxytocin	A stimulant of some plain muscles (e.g. the uterine muscle). It is produced in the posterior pituitary body.
Pineal organ	A "gland" on the surface of the brain, probably homologous with median eye-like structures in lizards and lower vertebrates (Pineal eyes).
Protozoa	Unicellular organisms, e.g. *Amoeba*, which moves by creeping, *Paramecium*, which moves by the beat of cilia, Trypanosomes that move by whip-like flagella.
Somites	Groups of cells serially arranged along the notochord of a developing vertebrate which give rise to the main trunk muscles.
Tunicates	Sedentary marine animals, whose larvae are free-swimming and resemble tadpoles.
Vasopressin	A stimulant of some plain muscle (e.g. of small blood vessels) and a modifier of cell permeability. Produced by the posterior pituitary.

Is it the Same River? *Gladys Keable*

An account of ten years work on the conservation and upgrading of the River Lee, a main source of London's drinking water; from conversation and material supplied by Mr. E. A. Drew, Chief Engineer and Mr. A. H. Potten, Chief Chemist of the Middle Lee Regional Drainage Scheme, at Rye Meads Sewage Works, Stanstead Abbots, Herts.

"You cannot step twice into the same river". No doubt when Heraclitus made his famous observation, it seemed as limpid, as sparkling as the Ephesian river he visualized. The sediments of time cloud our minds as well as our rivers, and the illustration would not serve the purpose of a latter-day philosopher so well, now that he knows about "recycling" and accumulative concentrations; and ancient wisdom has been further downgraded since, about ten years ago, it dawned upon the heads of state throughout the world that stepping into the same river twice is precisely what we have to learn to achieve, if civilisation is to survive. The ordinary citizen follows along behind, absorbing his principles and values by experiencing their presence (or absence) in his institutions, his workplace and his local government. That is why Rye Meads Sewage Works, on the river Lee, is to many people, including those who work there, an exciting place; for it is a successful pilot experiment in bringing about this man-made ecology, this cycle of use, rejection, re-structuring and re-use, which is what "man-tech" largely turns out to be about.

"Saving a river" is the title of a handsome brochure[1] by Mr. E. A. Drew, who has built up Rye Meads Works. On the front cover is a colourful picture of rippling blue water running between tree-fringed banks, complete with anglers and pleasure boats; on the back is a plant-ringed tank, lively with shining goldfish. One is an effluent outfall on the river Lee, and the other is the clear treated effluent of the works, indistinguishable from and largely identical with the river, into which it is on the way back.

The Water Resources Board of the U.K., in its third annual report in 1966, made it clear that there was enough water over and under-

[1] *Saving a river and conserving London's water supply*. E. A. Drew, B.Sc.(Eng.), C.Eng.M.I.C.E., F.I.P.H.E., M.I.W.P.C. (Brochure), published by Activated Sludge Ltd., 41 Buckingham Palace Road, S.W.1.

ground to meet all foreseeable needs till the turn of the century – but what still has to be battled for is the quality of this water. Prior to the setting up of the Board, this was rapidly deteriorating through all its uses, domestic, agricultural and industrial. For with all the new building, since the war, there has been an enormously increased demand for water, which is largely taken from rivers, and these same rivers are used for sewage effluent disposal; and the two purposes, regarded as antagonistic, are carried out by totally different authorities. So the task of the Board, within this ludicrous state of affairs, is how to manage resources, so that the right quantity and quality of water is available when we need it and where we need it. "All that we have so far learnt," the Board says, "indicates that as expected the biggest and most urgent problem is that of South-East England." London's drinking-water supply is the key issue, and that is why the history of Rye Meads is of such interest. This is how Mr. Drew sums it up in the brochure:

"86% of the London water supply is derived from river sources—of this, some 67% is derived from the River Thames, and 19% from the River Lee. At the end of the Second World War, it was felt that because about half of the flow in the lower reaches of the River Lee consisted of effluents from sewage works, many of which were grossly overloaded, it was a failing source of supply. Such then was the situation in 1946, when the Government embarked on a policy of New Town Construction – three of these towns, Stevenage, Harlow and Welwyn Garden City, with an estimated total population at that time of 220,000, were designated in the catchment area of the River Lee, whilst only two were included in the remainder of the Thames catchment. . . .

"The Metropolitan Water Board, the supply undertaking for London, and the River Authority, the Lee Conservancy Catchment Board, were therefore justifiably concerned at the prospect of reduced underground and service supplies, in and from the upper reaches, due to increased extraction from the chalk for water supply to the New Towns and other development, together with the resultant increased discharges of sewage effluents to a depleted river.

"Whereas for many years the conflicting interests of water supply and waste disposal has led to a slow deterioration of the quality of the water in the River Lee, with the introduction of the New Towns, a situation could be expected to develop which would reduce the river to a virtual conduit for sewage effluent.

"It was against this background that the Stevenage and Harlow Development Corporations, with the agreement of the local interested parties, i.e. the Lee Conservancy Catchment Board and the Metropolitan Water Board, finally decided to construct a Regional Drainage Scheme, with centralized sewage purification works below the confluence of the Lee Valley and its major tributary the Stort Valley at Rye Meads, near Hoddesdon on the borders of Essex and Hertfordshire, in order to deal with the drainage problem of the three towns in the Lee Catchment.

"It was the intention that these Works should (i) give all sewage full treatment and produce an effluent 'something better than Royal Commission Standard' and (ii) dispose of as much as possible of the effluent by soakage or recharge of the shallow gravel aquifers. It was appreciated also that if it ever became necessary for the well-being of the river, the effluent would have to be conveyed in a separate culvert 12 miles down the valley to a point below the Metropolitan Water Board's 'lowest' reservoir intake from the river at Chingford. Most important, however, there was to be close collaboration after the completion of the Works, in order that the interested parties could discuss matters of common interest in the attainment and maintenance of satisfactory effluent and river water quality. . . .

"In July, 1955, it was decided by the River Authority that they required the biological oxygen demand after five days (B.O.D.) and suspended solids (S.S.) content of the sewage to be reduced by about 99% and the free ammonia (NH_3) content by about 75% before discharge to the River Lee, and in fact their exact quality requirements for the final effluent were to be:

	May-Oct. incl.	Nov.-Apr. incl.
B.O.D.	5 p.p.m.	10 p.p.m.
S.S.	5 p.p.m.	10 p.p.m.
NH_3	10 p.p.m.	10 p.p.m.

Since the commissioning of the Rye Meads Works in 1956 every effort has been made to keep within these requirements. Despite the stringency of the standards, with the exception of periods in 1958/9 and 1961/3, when nitrification was lost due to inhibitory organic trade effluents, the effluent from the Works has met the free ammonia requirements and to all intents the B.O.D. standard. The concentration, however, of suspended solids is 'obscured' by the presence of algal growths in the effluent. This difficulty is seasonal and is particularly felt during the summer period, when the suspended solid standard is most onerous. Nevertheless with the exception of the two periods referred to, the diffused air process has produced a fully nitrified high quality effluent for 'polishing' in rapid gravity sand filters (maximum capacity 4 million gallons/day), and maturation lagoons prior to discharge to the River Lee. . . .

"It is apparent from the Reports of the Metropolitan Water Board that in the 11½ years since the Rye Meads Works was commissioned, the quality of the water of the River Lee has steadily improved so that it is now once again a good and reliable source of supply. Furthermore the water from that source would appear to be as desirable for supply purposes as that of any of the Undertaking's surface sources. . . .

"The statement is true not only because of the vigilance of the Water and River Undertakings, but also because of the close collaboration of those Undertakings with the Drainage Authority. It is probably the first time that a large Regional Drainage Scheme has been 'tailor-made' in an endeavour to meet the reasonable needs not only of the River and its users, but also the water supply of one million people only twelve miles downstream of that scheme. The success leads one to hope that it will be a pattern for the future."

Mr. Drew is a public health engineer, but what he picks out as "most important" is that "interested parties could discuss matters of common interest" about river water quality, and it is this, the total common flow of ideas and investigations and decisions that he returns to as a "hope that it will be the pattern for the future." This highlights our concern with "man-tech" as a discipline in its own right. We have only to look at how every drop of water on moon-flights, including that passed by the space men themselves, had to be re-used constantly to realise that the technology of re-cycling water has reached an exceedingly sophisticated standard. It has been done already with the Thames yet it is still a fairly new idea in local government circles, not yet reflected in the disparate administrative structure of water and sewage authorities. In the past, water for drinking has mostly been sought in the upper reaches of rivers, while the lower reaches have been more and more fouled by increasingly toxic sewage effluents, the two uses being regarded as "conflicting interests" or even in another report as "irreconcilable purposes". In the Lee the two were at grips with one another, and the only alternatives were a death struggle or total reconciliation.

In 1946 when the New Towns were designated, it was still quite an act of faith to try to resolve the conflict, since "there was no known sewage plant either in this country or abroad that could maintain a standard of effluent that would be acceptable for discharge into a river such as the Lee; and extreme doubt was expressed that any attempt to utilise large volumes of sewage effluents, no matter of how high a standard, as a source of potable water without adequate dilution in the receiving watercourse, would be acceptable"[2]. Happily a solution has been found, but it is not due just to technology as such, for Rye Meads disclaims any exceptional technical know-how, though of course they have the advantage of new plant and machinery, though of a kind already on the market. It is all done they say, by standard processes, which they describe as "screening and maceration, grit removal by constant velocity channels, and primary sedimentation, followed by secondary bio-chemical treatment by 'activated sludge' using diffused air. This is followed by a tertiary treatment using 60 acres of maturation lagoons 'assisted' by a rapid gravity sand filtration for 4 million gallons a day". They modestly admit to the lagoon treatment and their fish monitoring as successful innovations, but that is all. The entire revolution (for it is no less) is being achieved by the close collaboration in "matters of common interest".

[2] *Middle Lee Regional Drainage Scheme, Rye Meads Works* (Brochure). Harlow and Stevenage Development Corporation, 1970.

What exactly is achieved by this "man-tech" activity? In the first place, foresight. It is still not obligatory for planning authorities to give adequate advance notice to sewage authorities when new building takes place. River boards (yet another authority) can make conditions about the effluent they will accept, though it is difficult to get them enforced, but sewage works cannot limit the quantity they have to treat. In consequence one of their main problems is overloading and consequent spillage, particularly if there is also storm overflow. Rye Meads, as created for the New Towns with its joint authorities, is able to look ahead and plan its phased expansion to its ultimate 500,000 capacity; it has plenty of space, and is able to experiment in ways of using the space more effectively. Foresight can also be exercised on labour needs, but redundancy is unlikely to be a headache, because you cannot get enough skilled operators, and increasing automation is therefore an obvious goal. So although sewage is still legally the responsibility of local authorities, in practice, all but one of the towns and villages in the area have voluntarily come into the regional scheme. Gone are the days of the legendary council meeting, when faced with a suggestion for co-operative action, an alderman rose and broke into impassioned protest:— "Gentlemen," he cried, "let us be resolute, let us fight tooth and nail to keep our OWN SEWAGE in our OWN HANDS". But all this joint working (a gentleman's agreement in advance of the previous failure to agree) is still precarious, and will be so until there is new legislation, such as the new Government White Paper adumbrates (following the Maud Report plan for unitary authorities) but cannot yet define[3].

A further gain from the man-tech information flow is an incentive to positive instead of negative departmental attitudes and action. If a river authority imposes a condition for accepting effluent, and if the standard is not reached, uneconomic and irrational "I'm all right, Jack" devices may be employed, such as putting in long pipes and changing the outfall position, thus creating future difficulties for some other down-stream river users. But in the Middle Lee, because all authorities are working together, it is possible to have a much tighter control over what comes into the sewers and so eventually into the river. There is, for example, a directive set out about the permitted content of trade effluents, which should operate uniformly over the region, with a scale of costs per thousand gallons for use of

[3] Reform of Local Government in England. Cmnd. 4276. Feb. 1971.

public sewers, biological treatment and disposal of sludge.

This leads to the other aspect of the Rye Meads set-up, its research and educational function. Naturally it has a laboratory, and here Mr. Potten and his staff analyse trade effluent samples, taken at source from the industrial towns in their area, and also from samples taken inside the works; and there is also continuous monitoring of sludge in digesters on a thirty-day retention time and in aeration units on a 6-hour retention time. Finally the effluent is fed to fish-tanks containing goldfish, perch or trout, "for an early warning system, similar to that of the canary in the coal-mine". The fish flourish, and it is also possible to spread knowledge about the effluents which are dangerous to them and to the sewage. For instance an information sheet is available for farmers, which tells of a discharge of less than a gallon of organo-phosphorous pesticide, which both caused difficulties in sewage treatment and also killed 1,000 fish in the River Lee. A discharge of only 20 gallons of certain pesticides, they say, could produce a disaster similar to that in the Rhine, where all forms of life were killed for hundreds of miles. So Rye Meads not only *has* a lab., but it *is* a lab. where it is possible to study the many unknown factors in water pollution and purification which of course change all the time, with the use of new materials, e.g. detergents in the home and other chemicals, etc., in factories and on farms. For example, it seems that a bit of copper mixture in the pigfood is tasty and nutritious for the porker, but not for the sewage, nor for the plants and soil, if traces are left in the sludge. Who knows in what conditions this is likely to happen? To find out, a university chemistry student, doing his six months' industrial period in the lab., did a lengthy experiment to find out. This kind of work could be and should be multiplied indefinitely for tricky substances, such as nickel, silver, mercury, beryllium, cyanides, inflammable solvents, radio-active substances, halogenated solvents and so on. But the amount available for research is about 1% of the total expenditure on sewage disposal, and, since responsibility is fragmented, this is done in labs. duplicating experiments and expensive equipment, by authorities duplicating man-power, such as inspectorates. Much of the resulting information is totally unknown in those local authorities which do not have trained personnel, or which do not, in fact, wish to know.

Luckily the various laboratories themselves are developing an *ad hoc* system of collaboration as far as they can, so that, for example, three experiments are going on side by side at the Rye

Meads lagoons, one on algal growth by the Stevenage Water Pollution Research Lab.; one on invertebrate life by Westfield College, and one on fish by Chelsea College of Science and Technology. Research students from overseas are to be found in the lab.; last year a Ghanaian woman micro-biologist was there to find out what would be feasible to put into practice in a new country. There are plenty of problems which the Working Party on Sewage Disposal considered to be crying out for investigation; for instance, disposal of sludge in excess of requirements, since only about 2/5 can be absorbed agriculturally; sludge drying and incineration, which need testing out; safe and economic disposal of farm wastes, vacuum instead of water transport of sewage, as done in Sweden; and automatic and computer techniques and better criteria for assessing pollution. These are all national problems, as well as the testing of new plant and equipment; who is to initiate and pay for them?

This and much else was considered by the Working Party on Sewage (chaired and vice-chaired by two women, Mrs. Lena Jeger and the Marchioness of Anglesey) and set out in their excellent report, *Taken for Granted*[4]. Lest it should still be thought that too much weight is being given to the creation of one new *ad hoc* arrangement in the Middle Lee Region it is worthwhile to look briefly at their estimate of the overall situation in the country.

The 1912 Royal Commission's required upper limit for effluent is 30 m.g./l. of suspended solids, 20 m.g./l. of biochemical oxygen demands. 60% of local authority works fail to reach this standard. Rye Meads aims at and achieves 5 m.g./l. (S.S.) and 5 m.g./l. (B.O.D.), "this stringent standard for effluent quality is probably the most onerous ever imposed on a large Regional Works". Some hazards are growing all the time, e.g. in rivers and canals from overloading; from private sewage plants and industrial wastes; from accidental spills of toxic material, some of it new and little understood; from boats; and from oil. Yet more and more lower reaches of rivers are having to be used for drinking water, so there must be tighter and more integrated control, where pollution is such that stretches of the Mersey, the Don, the Trent and the Rother cannot support fish, and where the Lee for twenty miles down from Luton is 100% sewage effluent in dry weather, and from Ware

[4] *Taken for granted*. Lena Jeger. Ministry of Housing and Local Government. H.M.S.O. 1970.

downwards about 50%. So is the Avon at Stratford and stretches of the Rother and the Mersey. Add to this the continuing dilemma of estuarine and sea outfalls where crude untreated sewage is still released and where controls are much less stringent. As late as 1966 there was a public enquiry at Bognor Regis on a proposal for a *new* outfall of this kind 1½ miles from shore which was opposed by the M.O.H. But whereas this cost £1½ million, the product of a 1/4 (old pence) rate, an inland works would have cost 2/4, so the scheme was allowed. Opposition continued till a second enquiry was held, and some modifications, including maceration of the sewage, were introduced. By now, the cost nearly equalled the previous inland 2/4 rate, and the inland costs had risen proportionately; so the outfall scheme won again. Encouraged by this, Worthing and Littlehampton joined in a scheme for an outfall 2½ miles from shore, and not one person turned up at the enquiry to oppose. In these conditions, local authorities in isolation cannot take what they know to be the better course. As the Working Party gathered its evidence, it became clear to them that it was now impossible to separate the investigation of water supply, control of river and sea effluents and sewage treatment and disposal, so they unblushingly overstepped their brief, and recommended an overall national Water Authority, to decide policy and do research. "Whatever authorities are responsible for administration, there should be integration of sewage and water functions locally, as well as nationally and regionally". This trend towards unification was also accepted by the Maud Report.

Even closer unification has now been called for by the 1970 annual report of the Water Resources Board, since they want the river boards included. "New" comprehensive river basin authorities should be responsible for river management, water supply and sewage disposal, now split between river authorities, local government, joint boards and water companies[5]. There can be little doubt that such unification, besides its increased efficiency, could effect great savings in sewage disposal and water purification costs, though they are basic and necessarily expensive services. The yearly capital investment in sewage is £100 million. Rye Meads alone, since its beginnings in 1956, has cost £1,866,000 in trunk sewers, £6 million on the sewage works and the '69/70 revenue expenditure was £600,000, or 1½d. per person per day (in old coinage), which

[5] Annual Report of the Water Resources Board. H.M.S.O. Sept. 30, 1970.

includes charges relating to trunk sewers. It is obviously false economy to let the water supply deteriorate; savings in health bills alone would justify constant vigilance and improvements, but are there other benefits to set against necessarily increasing expenditure? Once more it becomes clear that the more complete the cycle, the more economic it becomes. At the actual works, the cost of processing exceeds any possible return, indeed the sale of sludge is at present not much more than chicken-feed, and it seems also at present there is little market for fresh-water fish in England. But in Germany and Japan it seems to be a profitable post-sewage source of revenue and more could be done about it over here by the more adventurous food shops; the Jeger Committee indeed recommended that thought be given to more positive marketing methods. Also with purer water, there could be more facilities for fishing, and so revenue from fishing licences. Rye Meads keeps down its working costs by using the methane gas released in the process as fuel.

But when we consider the total sewage disposal problem, it is difficult to believe that anybody has a clear picture of what total recycling would involve or what is the best way to work towards it. Rye Meads has three industrial new towns in its area, yet the sewage from trade effluents is only 25% of the total flow, and agreements for receiving it prohibit a large number of varied substances from entering the public sewers. What happens to these substances and the sludges arising from pre-treatment at the works? Large firms are able to do some of their own recycling, but small ones cannot, and it must be assumed that a large amount of these by-products are lost, and that some of them are causing pollution in the soil and elsewhere. Farm wastes are even more tricky, because even if the sewage works wanted to deal with them, farmers could not afford to pay the costs for more than a small proportion of the whole, yet some of it is far from suitable for going back on the land. In fact, public sewage works interlinked with the drinking supply are fairly wary of trade effluents. This part of the cycle links with both Tim Eiloart's and John Walker's articles[6] on what is and could be done by private enterprise in dealing with waste disposal; there is room for both joint action and agreed demarcation between public and private sections of industry. In the public system, with its fragmented administration, there is no rational way of allocating costs between users and dischargers, and the quality of water in one

[6] See *T. to T.4*, ii and iv.

place is determined by sewage disposal in another. If and when large unitary authorities are responsible over a region for the whole water and waste cycle, charges for trade wastes could be more uniform, reflecting conveyance, reception and treatment. Since this article was written, the Royal Commission on Environmental Pollution has published its first report[7]. It is heartening to know that the Commission, in its top priorities for government action, puts control of solid and semi-solid toxic wastes on land.

The Jeger Report carries its cost-benefit balance even further afield – for arriving, as we have seen, at the conclusion that the whole water cycle must be a totally integrated enterprise, the Report points out that the benefits from clean rivers, seasides and estuaries could mean an enormous increase in amenity and recreation facilities, such as boating, fishing, camping and so on, many of which could be financially paying propositions. It is therefore of some interest that Rye Meads, on the middle reaches of the Lee, forms part of a stretch of riverside country, which has been designated as the first regional country park in Britain. It stretches from Ware right down to the river, through the London marshes, ending, well on the way to the docks and the Thames at Millmeads. It is an imaginative project to provide conditions for a very wide range of recreation, ranging from riding, picnicking, boating, walking and golfing to eating, drinking and dancing by the river; there are to be nature trails, museums, an arboretum, a motor-sports centre, an aviary and an aquarium. All this costs money, and can only succeed if river pollution can continue to be successfully overcome. But it could also bring in a great deal of money. Sir Eric Ashby and his commission in their report are very strong on the necessity of uncovering the real economics of the pollution problem, before choosing priorities for action, even though other factors will enter into the choice.

"Where possible", they say, "we need an economic framework to aid decision making about pollution, which would match the scientific and technical framework we already have". (§84.)

This enquiry must necessarily be long and extremely complicated, and we would like to know whether in Sir Eric's opinion it would be valuable and informative to look at the problems and opportunities in one manageable area, to get an idea of what is involved?

[7] Royal Commission on Environmental Pollution, 1st Report H.M.S.O. Comnd. 4585. Feb. 1971.

"What we have to achieve" they say "is a combined operation between public opinion, economic incentive and legislation". The Lee Valley Regional Park, jointly sponsored by Herts, Essex and Middlesex, its new town industries, its opportunities for publicity in the park, and for the participation of voluntary amenity and conservation societies, surely offers, by chance or providence, all the necessary conditions for such a pilot project, in a setting which should win popularity and public support for the conservation cause.

Meanwhile at the time of going to press, we still do not have the necessary legislative framework for water protection, and alas, too much government white paper and good intentions end by choking Hell's gutters and litter bins. If the Lee Valley's exciting project is to materialise, it is this kind of responsible "man-tech" that must achieve it, by determined effort to make it possible, profitable and pleasant to step twice into the same river.

* * *

Note by Eric Ashby

One conclusion to be drawn from this essay is the need to unite, under one organization, those who control rivers, those who put purified or polluted water into rivers, and those who take water out of rivers. There are at present in England and Wales 1,400 separate authorities responsible for disposing of sewage; 29 river authorities, which receive sewage effluents but have no jurisdiction over sewage authorities, and 199 independent statutory water undertakers who supply piped water for homes and industry. This division of control over one of our very precious natural resources causes serious conflicts of interest. The embarrassment of the river authorities is that they are responsible for water resources in England and Wales, yet they have no adequate control over what is put into their rivers, nor over what is taken out of them.

The simplest administrative solution to this embarrassment would be to create multipurpose authorities, with responsibility over the whole water cycle in a river basin. Water would be purified and sold by the authorities to users (who might sell it back "second-hand" at a price depending on the degree of pollution) rather as gas and electricity are sold to users now. Most polluted water would be collected and re-purified by the authorities themselves, at a cost which would have to be recovered from the users through a precept on the rates. A new town or a new industry in a river basin would have to come to an agreement with the multipurpose river authority to buy water and to pay for the re-cycling of polluted water so that it can be returned to the river and used again. The whole water cycle could then be costed and managed as one economic system.

The Water Resources Board in its seventh annual report (to 30 September 1970) comes down emphatically in favour of this multipurpose pattern of administration, and its attitude is supported by the Royal Commission on Environmental Pollution. But not all the bodies concerned with the water cycle are in favour of it, and a General Advisory Water Committee (CAWC) was appointed in September 1969 to make recommendations in the light of the Maud Report on local government. The Committee's report is completed and will be published in the Spring of 1971; and the Government will then have before them all the information necessary for making a decision which will determine for decades to come the economy of our water supplies.

The Electronic Bureaucrat: *Yorick Wilks*

It seems a long time since 1964 when Harold Wilson's main platform point was a commitment to the automation and modernisation of British Industry, and to the insight that modern political life meant automation under socialism or mass redundancy under capitalism. Then came disillusion with the ability of the last Government to carry out that commitment, and, moreover, with the idea itself. Great numbers of people, not only in the Conservative Party and among the student radicals, but on the serious left also, began to say that extensive use of computers in our society might be a very bad thing indeed. Nor is that phenomenon particularly British, for the voices of disillusion sound louder in the United States, where most of the computers in the world are. There is a general failure of what Paul Goodman would call "millenarian nerve".

The crisis, if that's the word for it, stretches out in other dimensions: it passes beyond a universal dissatisfaction with the way things are being run in science and industry. The same author would say that we have a "religious" crisis on our hands, and that "an attack on the American scientific establishment is an attack on a world-wide system of belief".[1] It certainly stretches more widely than technology and science; and extends at least to the criticism of social authority, particularly bureaucratic authority, and to centralised bureaucratic authority at that. None of these aspects of the problem are new: religious crises have been survived before and, after all, it was not Mr. Heath who first thought of the idea of "getting the Government off people's backs". The writer of the *Tao Te Ching* warned rulers that,

> "Listlessly govern
> Happy your people
> Govern exactingly
> Restless your people".

The US Government's better conceived programs are off-the-cuff proof, if it were needed, that the use of advanced technology,

[1] P. Goodman, "Can technology be humane", *New York Review of Books*, 20 Nov. 1969.

together with centralised planning, does not lead necessarily to the laudable humanist goals of the planners, The increasingly general acceptance of that belief has created a particularly difficult position for what one might call the traditional Fabian, to whom it was first principle that the most efficient, reasonable, and scientific use of resources, guided by a properly intentioned Government, were all that was needed to settle most of a country's domestic political problems. He is more than usually beleaguered between left and right, because opposition to centralised technological planning is a point on which much of the left and right now agree.

I want to argue in such a way as to allay some of the fears I have mentioned. I want simply to assume that many of the grosser manifestations of our new technology can be self-correcting, given the proper legal and economic measures,[2] and that technology can in principle destroy all the garbage it produces. With regard to the second Industrial Revolution, in particular – advent of the computer, intelligent machine or what you will – I want to argue that:

(a) the manifestations of the "computer nightmare" are much further off than many of the news media lead us to believe.

(b) much of what people fear would in fact be good and useful, and, in any case, far far better than the alternative, what I shall call the "Kafka nightmare".

(c) fear of scientific development is particularly inappropriate on the left, much of which should know better.

(d) a range of traditional socialist goals can be reached with an extended use of a computer technology, and even with that at present available.

(e) such goals would be concerned not just with welfare, but with more tenuous notions like human freedom and the democratisation of social control.

In many ways an extended computer bureaucracy could provide

[2] The threat most written about is that to individual privacy from computerised records, which I don't intend to discuss here. There is no doubt that with the use of pass-words, and areas of a computer to which access is difficult, it is possible to keep the wrong people away from information. In commonsense terms, it would be an extension of the means now used to keep a computer user from destroying the program he's running.

The extent of the danger has been surveyed in such books as A. A. Thomson, *Big Brother in Britain Today*, London 1970. Technical suggestions to counteract abuses are contained in the works of Paul Baron of the RAND Corporation, and of Prof. A. F. Westin.

the advantages of decentralisation without sacificing the traditional advantages of centralised information and planning.

This whole note is really a plea that socialists should again take technical advance *seriously*, as most Nineteenth Century socialists took it seriously.[3] If one thinks of the tradition of scientific socialism it seems odd that one should have to make such a plea. Disillusion with science now seems almost total on the left, and yet there is no reason, simply because one has given up Marx's belief that scientific advance *must* bring socialism with it, to stop looking to see whether in fact it might, or could be made to do so.

In what follows I make a suggestion as to how radical automation, not so much of manual labour as bureaucratic labour, could go some way towards meeting the demands of workers' control as well as contributing to other traditional socialist goals. What many concrete demands for such control come down to are *access* not only to records and company accounts, but to the determining factors in the decisions taken at the top level in any company. It is these latter that many companies keep firmly to themselves, on grounds of their complexity as much as their confidential nature. It is just this access to records and the bases of decisions that bureaucratic automation could improve; and the more accessible such vital facts are, the easier is spread control over the use made of them.

What is needed in Britain, at least as much as the automation of manual labour, is that of other fields of activity, and in particular, large areas of bureaucratic and managerial society. It is a presupposition of everything else I have to say that there could be such automation, here and now, with the computers at present available. I am not discussing a *possible* situation where the outstanding problem of "artificial intelligence" had been solved; a situation, that is, where machines could at least translate languages adequately and be said to understand what they read. The reports one reads frequently in the papers saying that computers can do *these* things are almost necessarily false. That can be known with some certainty, because any such technology must be preceded by successful research, and, as of now, the relevant research has just not been done. The United States Government, in particular, invested a great deal of money between 1955 and 1965 in what was called

[3] [Yorick Wilks addresses this article primarily to socialists; we believe that what he has to say concerns anyone interested in what is happening in our society, including Christians, whether they are socialists or not.—Ed.]

Mechanical Translation. By and large all that work, including most research in what is usually called Computational Linguistics, came to nothing.[4]

There is not, and never was, anything wrong with the machines themselves: they are still the faithful plodding slaves they always were, faster and more compendious than ever. Three feet of the magnetic tape most computers use can now store all the contents of a 300 page book, and a commercially available computer can read those contents in 10 seconds.

What is lacking is the programs, the routines written by programmers, that will make these machines show more than minimal intelligence or judgement. Much more could be done now with the computers and human ingenuity already available, but there is no sign of any impending blossoming of machine intelligence that should make anyone feel in the least threatened. It is not known whether there are any theoretical limits on the intelligence a machine *could* show, other than a highly formal one in the field of metamathematics.[5] What is sure is that any advances will produce more *machine* intelligence. It will never, nor could it be, *human* intelligence, and I think many people's worries arise from identifying the two.[6]

The main reason why we are not nearer to the automation we could now have is that there are probably ten times more computers per million population in the United States than here, though when the Conservatives came to power nineteen years ago we had the only large computers in the world. And, it should be added, that after six years of Labour rule our ailing computer industry was little better off and could even now succumb entirely.

A simple number count of computers can be misleading these days because they come in many sizes, but what is sure is that by any measure we have less computing power per head of population, not only than the United States, but than almost every country in

[4] The official epitaph on those millions of dollars for research is contained in *Language and Machines: the computer in translation and linguistics*. Government Printing Office, 2101, Constitution Ave., Washington, D.C., U.S.A.

[5] Some would argue that there are much lower limits on machine intelligence. See the highly readable H. L. Dreyfus, *Alchemy and Artificial Intelligence*, December 1965, Memorandum P.–3244 of the RAND Corporation, Main St., Santa Monica, California, U.S.A.

[6] [See also H. L. Dreyfus, *Pseudo – Strides towards Artificial Intelligence* in T. to T. II, ii, January 1968.—Ed.]

Western Europe. We are a very long way indeed from the reported[7] situation at the Massachussetts Institute of Technology where a $35,000 computer was stolen and not missed for weeks.

A second main reason for backwardness in the U.K. is not only the lack of desire to invest in computers but the many things that go wrong when British management do buy them. They install them often enough as a concession to what they think of as public, or shareholders' opinion, but then fail to create the conditions in which the machines can be used efficiently. It has been argued recently[8] that over 40% of all the computer installations in the U.K. are inefficiently run. What that means in many cases is that their use is restricted to payroll and account calculations, which are the sorts of manipulation they do least well. One reads complaints from managers and administrators that their clerical workers are not being replaced by computers in the way they were led to expect, but the reason is usually the way the machine is being used, or misused, by that particular organization.

There is a parallel here between the "concessions" made by management to workers on the one hand, and to the forces they see as pressing for the installation of computers on the other. In both cases certain forms are gone through, but in neither is there any real penetration, or disturbance, of the existing management situation. Yet, as Stafford Beer[9] argued, in the computer situation, that is exactly what must happen if there is to be any point in installing powerful computers at all. The set-up itself must change to accommodate them, which means *changing the form of the information* passing through the system of organization. In practice that means being far more selective about information: not so much about what goes into the machine as about what comes out. A classic case of failure to observe that was reported[10] recently. The members of the Finance Committee of Inverness Town Council were presented with accounts in the form of a continuous folding sheet of 200 big paper pages 105 feet long. One member of the Committee recorded his comments on trying to understand a document spread all over the walls and floors of his home.

It could get a lot worse without the use of more intelligence and discipline when producing information from machines for human

[7] *Times Business Supplement*, 27 October, 1969.
[8] *Observer*, 7 June, 1970.
[9] Stafford Beer, *British Institute of Management Bulletin*, Vol. 1, No. 11.
[10] *The Scotsman*, 28 August, 1969.

consumption, rather than that of other machines. For example, the U.S. Government records take up some 25 million cubic feet of paper. If you were to throw away a page a second, it would take over 2,000 years to get rid of the lot. Yet, even a fairly old fashioned computer can turn out a pile of paper a mile high in a year. It is that sort of possibility that led Joel Kibbee[11] to suggest the need for a "data retriever's licence".

But, of course, this isn't a horror story and machines can and should be programmed to produce output for people with finite lifetimes. Moreover, the world of computers is itself changing. For the purposes I am discussing the machine that produces a pile of paper a mile high – it is the same as the large fizzing machine one sees in all cartoons about computers – is itself out of date. The important revolution of the last few years, from the point of view of the person who wants to use the computer, is the real-time multi-access system.

"Real time" means that a job doesn't just go into the works of a computer with an answer popping out so many minutes or seconds later, for in real-time a human operator can be informed whenever he wishes of what is going on inside the machine. He can stop the process at any point and offer new information; or he can ask for an up-to-the-minute report on progress. In that sense the machine is working within the same, or "real", time scheme as the human operator, and not only one determined by its own operations.

"Multi-access", on the other hand, means a machine that many people can use at once; usually by means of mechanical typewriters (teletypes) or screens, that both the operator and the machine can write on. These teletypes and screens can be in the office or home, and at any distance from a central machine to which they are all connected.

In both these ways the modern computer has moved away from the popular image of the big "batch processing" machine, capable in many people's minds of controlling human beings as if they were robots. The real-time multi-access machine, which need cost only £2,000 while being as powerful as the biggest computers of 20 years ago, is much more suited to the role of "electronic bureaucrat": not a controller at all but by turns a secretary, helper, advice giver and administrator.

[11] J. M. Kibbee, *The executive and the information explosion*, System Development Corp., Santa Monica, Calif. SP–2777, March 1967.

I shall want to argue that many of our present man-bureaucrat relations would be better replaced by man-machine, or rather man-electronic bureaucrat, relations, and that much more could be done along those lines with the machines and programming skills at present available. What would be examples of these dispensable man-bureaucrat relations?

One of the best places to start is tax calculations. Unlike the United States, the British authorities still want to check every tax payer's returns. In the United States one taxes oneself, and only a sample of the returns are individually checked. This simplification enables the U.S., with four times our population, to manage with about the same number of tax officials as ourselves. Added to that problem, the structure of our tax system is so complex that in one case, that of Corporation Tax, the officials simply refused to calculate it on its introduction and, one might add, why should they?

If British Tax Policy remains what it now is, then there is clearly a situation ripe for bureaucratic automation. But what of the man-bureaucrat relations involved? How many people do not understand their annual tax declaration forms, or their code or tax assessments, yet know that there is nothing to be gained by trying to locate a helpful official in the local Government rabbit-warren?

It is not hard to imagine how different things might be. Teletypes could be made available in large numbers in public buildings, so that those who wanted could be asked questions at them, and their answers would themselves constitute that person's tax return. A simple system of identifying the user by means of a plastic card inserted into the teletype, or better still by the use of pass words, would prevent a return being filed by the wrong person. If, at any point the tax payer did not understand the question he was being asked, he could type that in, and have the questions simplified or rephrased.

A situation even more suitable for this approach is welfare benefits. It has been revealed[12] that the Ministry of Social Security issues over 3,000 kinds of claim form for all types of benefit, and administers about the same number of *kinds* of means test, while the local authorities administer 1,733 means test schemes (3,146 with rent rebate schemes added in). Not surprisingly, the same report reveals that over 90% of poor families fail to obtain the benefits to which they are entitled.

[12] *The Times*, 17 October, 1968.

It has been proposed to remedy this by producing a booklet on "welfare rights",[13] but the difficulty then remains that the people most in need of it will be among those least able to obtain and make use of it. How much easier if the applicant had to do no more to start with than to sit at the teletype and type the word "help". Perhaps some less paternalistic and emotionally loaded word would be better, but that happens to be the one used in many programming systems to teach beginners the programming language to use. Once contact had been established in that way, the system could elicit, by means of a series of careful questions, the applicant's resources and needs, and then inform him exactly what he was entitled to. He could even make his claim formally during the same session at the teletype.

This possibility of tailoring what an American would call a "welfare package"[14] to an individual is the obverse of the common fear about computer storage of personal details. Storing personal details of this sort can enable people to be treated individually by a system *in ways that they want*, and in ways that would not be possible with merely human administration. Only with these sorts of contemporary bureaucratic advances can, for example, a big firm contemplate paying only those employees by cheque who want to be so paid.

A case where something is actually being done in this country is the calculation and despatch of all allowances that normally come by post – unemployment pay and so on. A system to calculate these and then address and despatch them is at present more than half programmed. Here one's complaint might be that although something is being done, the Government have not made this fact clear and public enough. But what about applications for passports; why do they still take three weeks? Development permission, permits and grants of every kind could be printed out more or less on the spot if the relevant information was provided for the computer by teletype. Student applications for admission to the Universities is another case crying out for some kind of automation of this sort.

[13] T. Lynes, *Welfare Rights*, Fabian Tract 395, July, 1969.

[14] J. Cogswell et al., *Design of a man-machine counselling system*. System Development Corp., Santa Monica, Cal. SP-2576, 1966.

J. K. Harris, *Automating Welfare*, System Development Corp., SP-2698, 1967.

R. M. Lind, *Automating Welfare – a commentary*, System Development Corp., SP-2699, 1967.

Again, it has often been pointed out that if overworked magistrates were reminded at the time of previous sentences in cases like the one they were trying, then the whole slow process would be speeded up, and at the same time something done to remove the scandal of "same offence, different court, strikingly different sentence".

On a different point, we could improve on the Swedish national list of job vacancies. Anyone contemplating a change of job should be able to sit down at a teletype, specify his qualifications and wants, and immediately get a typed selection of nation wide vacancies on the spot, with no copying or form filling. What, apart from cheap housing, could be more conducive to the greater job mobility we are always being told we need? And that would be only a first stage. With the developments at present available enabling machines to communicate with each other, it would be possible for the same man at the same teletype to initate applications to the machines of the firms of his choice.

In all these examples, the important common factor is that it is now a quite straightforward matter for the untrained layman to sit at a teletype and retrieve information from a computer. Nor does he have to know *in advance* exactly what it is he wants to know – that can itself be settled in the course of a dialogue between the user and the machine.

But my main point concerns not obtaining information but decisions, even though there is no clear line between the two. For deciding *what* information to give, or to ask for, in a given situation is clearly a decision itself.

A remark at a recent conference[15] could serve as a "negative text" for what I have to say. Speaking at a Council of Europe Conference on safeguarding privacy, a M. Juvigny said:

> "Once one relies on a machine to 'rationalize' options in expenditure, planning, development, military policy, education and the like, with all the rigidity that machine-made choices involve, then the very concept of democracy may be jeopardized."

It takes no great care to see that the force of this quotation comes from the pun on two senses of "rigidity". But as to its main claim, how may democracy be jeopardized? For it seems to me that, on the contrary, the possibility of automating large areas of our present managerial and bureaucratic structure offers not just added conveniences, but new possibilities of advance in our general

[15] *The Times*, 2 October, 1970.

thinking about society. The very existence of an "electronic bureaucrat" would effectively divide administrative decisions into two kinds. On the one hand, there would be those decisions that the mechanical bureaucrat was competent to take. These would be the vast majority of them; the routine decisions and those that result from direct calculation of any kind. On the other hand, there would be the decisions that it was not competent to take, those which required human judgement. These latter decisions would be the important ones and, to go back to the industrial context, they would be decisions which one might expect workers and citizens in general, to *want* to take part in making. Among the decisions needing human judgement would be those about what goals an electronic bureaucrat would pursue in taking its decisions. But, without some large-scale separating mechanism of the kind I am suggesting, problems like workers control will always get bogged down simply because of the *enormous number* of potentially mechanisable decisions that are required to keep any complex modern enterprise going. The first step is some such separation of the important from the unimportant.

An obvious drawback to any mechanical method of reaching decisions would be that anyone who accepted the goals and permitted methods that were submitted to the machine would be committed to accepting its answers, or decisions, as well. Unless, that is, there was also some procedure for reneging on those decisions if one really couldn't face the consequences of what it came up with. To take an absurd example, if the now notorious "Pentagon computers" were to come up with the suggestion that in the interest of world security nuclear weapons should be given to state X, then one might want to give up some premise of their analysis pretty smartly.

One *psychological* result of this way of going about things is that it would reduce, or eliminate, the present ability of those in power to rationalise their decisions; that is their ability to produce *some* reason for whatever course of action they had already decided upon. That kind of *ex post facto* justification would become irrelevant, and we would have to face up to bald decisions together with an invitation to inspect the premises, the program and the works.

But that situation would not be in any way a jeopardization or diminution of democracy. On the contrary, the fact that the real goals of any decision system would have to be clear enough and public enough for a machine to operate them, would allow of greater democratic access to a notoriously murky area of British public life. Since the publication of Hewart's *The New Despotism* in 1926 there has been a slow but real erosion of the doctrine of Crown Privilege – the non-production in public of any of the facts that enter into a decision by a Minister or officials. This is shown in the Donoughmore Report, the Franks Committee's recommendations on tribunals, and the report in 1968 of the Select Committee. The automation of the bureaucracy could only assist in this trend, for the principles on which a machine works are always more accessible to judicial and democratic control than the unexamined principles of officials. Principles for an electronic bureaucrat must, and always will of course, have to be chosen by human beings by whatever political means are thought proper. And again, there will always have to be tribunals, and other human decision procedures, for the border line cases that are bound to arise in any field, where no automatic system would be competent to take a decision. But for the rest, there would then be a perfectly clear record of exactly what facts were and were not taken account of in the case of any particular decision. The printing out of reasons for decisions would then be not an occult but a routine matter. For, as Lord Denning put the matter recently *à propos* of legal decisions, if the reasons for decisions are not given the decisions may be thought unreasonable.

In making a case in very general terms I have conflated together the notions of bureaucracy and management: their growth seems to be a single phenomenon, witnessed to in East and West by James Burnham, C. Wright Mills, William Whyte and Milovan Djilas among others. The difference in their relative sizes in different countries is less important for this argument than their qualitative similarities. In this country it has always been Labour Governments that have been blamed for increasing the number of civil servants faster than ever before. And this criticism is both right and wrong. It is wrong in that socialist policies always require more *administration*, however little actual redistribution they involve. But the criticism is right in that the last Labour Government gave little sign that it understood the real nature of the automation problem. Indeed modern legislation carried through by any party requires so much detailed information and precise operation of rules for its application that it is not clear that it will always be possible to execute it, as we do now, even with an infinite army of civil servants.

But one ought not to look at such a policy or situation primarily from the point of view of a civil servant or manager operating it, but rather from that of a member of the public, or employee, on the receiving end. The great restriction on the freedom of such a person is that he is subject to the mistakes, and above all the arbitrary decisions, of the official, where by "arbitrary" I mean decisions not taken in accordance with some rule. It is well-known that the rules for taking such difficult, but rule-governed, decisions as tax calculations are often not obeyed for a number of reasons: complexity, tiredness and sheer bloody-mindedness among them.

Those reasons should be thought about carefully by those who react automatically at this point in the argument and say that nothing should be done to diminish personal relationships. I do not honestly believe that many welfare recipients would miss the humanity of the foghorn system, the loudspeaker that calls applicants over to a desk to talk to an official of the Ministry of Social Security. Moreover, there is always in these encounters an "adversary" element: an implicit struggle between two people, one of whose aims is to get what he can, while the other's is to safeguard and husband precious resources. I am sure many welfare recipients, to name only one important class of user, would welcome any change to a situation where this element was removed. An electronic bureaucrat could, or rather need, have no aims other than to pay those who satisfied the requirements, unlike many of those who administer the present system. People might well grow to welcome the increased fairness of an electronic bureaucrat in just the way that they usually prefer automatically controlled traffic lights to a policeman standing in the middle of a road junction.

At this stage it might be thought that I am relishing the thought of more laws and a society wholly in the hands of machines, and conclude that, since that would indeed be an Orwellian nightmare, there is no point in reading on. Such thinking is a mistake in that it ignores, or forgets the *Kafka* nightmare: modern man struggling from one to another of an infinite series of officials and forms. Anyone who remembers the shots in the film *Black Orpheus* of Orpheus searching the derelict, draughty warehouse-cum-ministry will know what I mean. Part of the terror of Kafka's *Trial* is its sheer time-consuming tediousness, not simply the subjection to the whims of officials, and their universal passing of the buck to officials ever-so-slightly higher up. That sort of thing is one of the real nightmares of our times, as most citizens know by now. It is by comparison with this that any serious attempt to mechanise, and so reduce, the bureaucracy could bring more freedom to the general public. That assumes, as I pointed out earlier, that computers themselves are disciplined so as not to contribute to a Kafkaesque Everest of paper, and not to refer their users on to other machines. The last possibility is highly unlikely, since one clear advantage of machines that is being increasingly exploited is their ability to communicate with each other without the intervening sources of confusion that human beings are subject to, such as noisy phone lines and the mail service. A computer connected to another directly or by land line cannot distinguish the other from part of itself, and so all dialogue becomes internal, which fact is already being used by banks transferring credits to each other without the use of the mail, and by firms which simply order goods direct by means of communication between their respective computers.

It is important to say again that the radical automation described here does not imply control of our lives by machines, in any serious sense. On the contrary, its implementation is a condition of freedom in the world into which we are moving, freedom, that is, from an infinitely large and complicated human bureaucracy. Anything that mechanical bureaucrats can do is both surveyable and checkable principally because they can be communicated with in languages as close to English as need be, and can be checked against each other. Suppose that someone disagrees with a machine's decision about himself, let's say it refuses him a passport. The simplest thing for him to do would be to try the application again on another machine; that is, to put it through again. Compare that with the almost impossible persistence needed to put an enquiry through the Civil Service twice! It is always possible that a machine could make a mistake – a chance of, say, a million to one. The chances of *two* such machines making the same mistake is then a million million to one – as near impossibility as makes no difference.

P. M. Blau[16] has argued that the challenge of bureaucracy is met if citizens "are motivated to devote time to decision making which has repercussions in the society as a whole". That is all very well, but unless the suggestion is accompanied by technological suggestions it seems pretty empty, because it misses entirely the point,

[16] P. M. Blau "Bureaucracy in modern society", p. 118, New York 1956.

analogous to the one I made earlier about workers' control, that there are *so many* decisions to be made in a modern society that no one has much idea what it would be like to implement such a sentiment. The only alternative, it seems to me, is to hand over much of the decision making to the machine, *thus leaving it clear which are the important decisions*. There are dangers in any kind of delegation of social power, of course: the danger of a new priest class of programmers and systems analysts; the danger of what M. Dubarle called the "machine à gouverner"[17] but what road to freedom does not have its peculiar dangers? The point is to see them for what they are and control them.

There would, naturally enough, be considerable resistance to any or all the suggestions here. There is the universal resistance, diagnosed in detail by Weber, of any bureaucracy to any diminution of its power. There is also a perfectly understandable resistance on the part of the Civil Service to any cut back in the number of established posts. But there is also an enormous fund of public goodwill for such measures, at least if a recent poll is correct[18] in putting "reducing the size of Civil Service" at the top of the public's list of priorities for Government. But it would have to be generally seen that measures of the sort described here lead to simplicity and ease in everyday contact with officialdom: that life without tax forms was a good thing.

What is astonishing is that the prospect of the Kafka nightmare does not arouse more horror. Perhaps it is all part of a wider hallucination that every thing must be *run* and that nothing works by itself[19]; that without drugs bodies would stop functioning, just as without a Government and its bureaucracy continually controlling and cajoling us we would all stop doing anything, and the public body would die. But there is no reason to believe any of this: it might continue to run quite happily with the aid of electronic bureaucrats, but with human beings taking the important decisions.

The real resistance comes from those who, in the end, fear the Orwellian nightmare more than Kafka's; who suffer from an

[17] *Le Monde* 28 December, 1948.

[18] *The Times*, 27 August, 1970.

[19] These notions are explored in the works of Paul Goodman: see particularly *Persons or Personnel: decentralizing and the mixed system*, New York 1965.

extreme form of what Eric Moonman calls "computer fright". When looked at calmly and in detail, most aspects of this fear are seen to be unreal, or to spring from the society from which the examples are drawn rather than the use of machines.

The control of an electronic bureaucrat may not turn out to be a simple matter, but it must be possible. What will never be possible will be popular control over proliferating Orwellian, and all-too human, Ministries of Peace, Love and Truth.

Safety in Numbers? *John Wlilett*

Just as the illiterate sometimes show a quite unreasonable reverence for the power of the written word, so the innumerate (like me) are apt to look to mathematics as a superior magic which will bring a new sure-footedness into human affairs. Familiarity does not always breed contempt, but unfamiliarity does create awe, that mixture of respect and apprehension which is today felt for such mystical institutions as psychiatry and the computer. It is a less reliable sentiment than the theologians used to suggest, for not only does it imply a considerable lack of understanding but it easily swings over into hatred just as soon as its object fails to live up to our hopes. At present this is in some danger of happening with both the institutions mentioned; because people do not know what they can or cannot be expected to do, they begin to detest them as some kind of sinister menace. It could likewise happen to certain uses of applied mathematics, if these too begin to disappoint the highbrow layman who has been told that they will renovate his particular subject. So should we not try to establish their limitations before we come to rely on them too much? Unless we do this there may be some nasty surprises in store.

As human problems become more complex, and the humans themselves thicker on the ground, we have become adept at expressing facts in a form where they can be mathematically analysed or projected. At the same time we have made ourselves machines which absorb, sort and operate on such facts more rapidly and more completely than was ever possible before. Of course this is a marvellous thing; it is indeed our chief hope of mastering the fantastically elaborate and overcrowded world in which we live, and it represents a particular challenge to the British intellectual community because, more than most technologically advanced peoples, they have the necessary flexibility of mind. None the less I doubt if those who are doing the real pioneer work in this area have any idea how dangerous a little mathematics can be to the more bone-headed among us. Even the most sophisticated statistician can make mistakes, and even the most expensive computer produces the wrong answer if the numbers fed to it in the first place give a wrong account of the human situations which they are supposed to stand for. Think then what must happen with the mathematical incompetents who dominate so many sectors of our society: politicians, managers, teachers, artists, soldiers, doctors and the rest. Quantification, they are being led to believe, produces conclusions that cannot be queried. So they apply it in their own amateurish way, and learn far too often to distrust judgements based on experience, insight, intuition, a sense of ethics or aesthetics, or anything else that cannot as yet be expressed in figures.

Given a choice between a line of action (or interpretation) based on accurate statistical analysis and one deriving from ordinary human prejudice no sane man would hesitate which to follow. But all too often the choice is rather between a set of debatable figures whose implications are imperfectly understood, and the kind of commonsense verdict which one used to take on trust because the person giving it clearly knew what he was talking about. The trouble is nowadays that it has become fashionable to regard anything based on figures as achieving a higher order of certainty than other kinds of reasoning. In a sense it is because numbers, in many fields, are a new toy. The use of demographic evidence in history, for instance, of mathematical permutations in music and the visual arts, of polls in politics and surveys in sociology, has successfully challenged all sorts of accepted ideas. Specialists have come along whose livelihood depends on persuading us that non-numerical evidence can no longer be trusted: psephologists, market research men, operational researchers, experts in "scientific management" and all the rest. The parrot cry is "can you quantify that?"

As a result, it has become almost inacceptable to say "most people sleep lying down", yet perfectly convincing to say that 83.2% of a sample of thirty-seven have filled in the right box in a questionnaire saying they do so, particularly if the relevant survey cost a lot of money. Similarly an aesthetic decision based on any kind of playing with numbers is regarded as objective and in some way intellectual, where one that is due to the artist's own choice seems merely old-fashioned: this despite the fact that the artists or musicians who adopt such quasi "scientific" stances can be singularly shaky in their arithmetic. Designers rely on modules, grids and ergonomics rather than on their own eye to tell them what shapes and proportions are right. Historians turn away from grand panoramas, with their consoling but largely discredited notion of a "meaning" in human events, to the minute dissection of quite small incidents into their component facts and figures. Personally I find all this extremely interesting, for wherever we can successfully harness mathematical disciplines to the material involved we are likely to gain all sorts of new insights. None the less there are sometimes less laborious ways of coming to the same conclusions, and in many cases they are better within the grasp of the people concerned.

Even where quantitative techniques are faultlessly applied they cannot possibly provide all the answers. Not all qualities are quantifiable, whatever Engels may have said, and a great deal of our life depends on actions and decisions to which mathematics can as yet make little or no contribution. A hundred years ago there were still unsurveyed areas on the map of the world, and the same is true of large areas of human experience today. This doesn't mean that they never will be surveyed, or that there is any reason to hesitate about doing one's best to investigate them scientifically. But for the present we can only move through them by other means – in effect by following our more or less gifted noses. In the natural sciences, from what I can gather, this is now well understood; the principle of indeterminacy, together with an understanding of the role of intuition in scientific discovery, has destroyed the hopeful picture of a well-ordered universe whose laws were only waiting to be codified. The scientist has to make guesses like everybody else (even if he is better equipped to know what to do with them once he has made them). Some of the factors that help shape these are very far from the layman's picture of what is "scientific".

What I am asking, then, is that we should be dubious of the current tendency to regard any results of quantitative research and analysis as being ipso facto more solid and reliable than those derived from other forms of intellectual, let alone intuitive approach to human affairs. They are only so in so far as the sums can be checked, though sometimes it is not so easy to check their original sources (did the questionnaire pose the right questions, for instance; were the respondents giving truthful answers?); and often they prove to have been arrived at already by other means. The danger is that by giving too much weight to quantitative methods we shall discourage people from exploring any areas where those methods can as yet not be applied; we shall come to underrate the rest of our intellectual equipment, and become increasingly rusty in its use. I am not meaning to talk as a "humanist" (whatever that is) against the scientists; it's my impression that scientists are quite as humane as anybody else, and likely to be much more alert to any flat-footed use of numbers as an obstacle to thought. Nor do I doubt that the techniques involved in the various fields – from stochastic music to computerised war games – will become increasingly sophisticated and successful. But there will always be blank patches on the map, and they must not be ignored.

There is a practical corollary to this argument. We are proposing to run some articles in The Times Literary Supplement in which people active in a variety of different fields will discuss the use of mathematical methods and say what gaps these appear to leave. Do they, for instance, squeeze out the human element in history, sociology and economics; do they discourage the scholar himself from using his commonsense; are they in fact as incontrovertible as they look? Similarly in the creative arts: are the mathematical patterns really the motive force, or are they a half-understood pretext for what are essentially aesthetic decisions? Even in the field of statistics, which one would expect to be at the heart of the whole business, I suspect that the real experts see all sorts of uncertainties and limitations which the figures themselves fail to convey. Certainly this is much too large a matter for any single person to encompass, but it is my guess that the same kind of drawbacks will turn up all over the place, enough perhaps to provide a cumulative jolt to some of our assumptions about the magic power of numbers. That will, I hope, not discourage anyone from trying to apply, refine, speed up and cheapen such techniques. But it may prevent us from expecting too much of them, or giving too subordinate a place to allegedly less objective modes of art and thinking.

Do the Rivers Pay Court to the Sea?

*The Unity of Science in East and West**

Joseph Needham

It is a commonplace of student thought that some forms of human experience seem to have developed in a more obvious and palpable way than others. It might be hard to say how Michael Angelo could be considered an improvement on Pheidias, or Dante on Homer, but it could not be questioned that Newton and Einstein and Bohr did really know a great deal more about the natural universe than Aristarchus or Chang Hêng. As a historian of science I am not necessitated to give my opinions about the arts or religion, but within the field of the natural sciences themselves a large question does arise in this context of evolutionary development – of real progress – over the ages. Has it been a true unity? Has science and technology been one single thing from the very beginning, or have there been a series of incompatible forms of it in the different civilizations which have emerged?

It is now just about thirty-five years since I first came in contact with Chinese scientific colleagues and learnt something of their language as a relaxation from scientific research. It did not at first occur to me that a tremendous intellectual job was waiting to be done here, for I was content to enjoy the introduction into an entirely new world of the spirit, to gain an orientation in a literature as great as that of Europe, and to begin to see everything through distinctively non-Western spectacles. The written language was a delight, and escaping from the alphabet in reading a page or two of it was, I used to remark, as enjoyable as going for a swim on a hot day. Still, as I began to know my Chinese colleagues better, the more exactly like myself I found they were, and this awakened grave doubts in my mind – how could they be so intelligent, so subtle and so philosophically penetrating, when actually modern science, of which we were all the devoted practitioners, had originated only in Europe at the time of the Renaissance and the scientific revolu-

* Part of a lecture given for the Cambridge Faculty of Divinity in the Michaelmas Term 1970.

tion? This was why I began to search eagerly for anything that had been written on the history of science in China.

The result was very disappointing; there was nothing of importance in any Western language, except occasional speculations and *obiter dicta,* plus a very few old monographs on particular sciences; while in Chinese there were only similar monographs rather more recent but without awareness of the general problem that was worrying me. So I would have to do the job myself. At first I pictured only a single small volume, or a pair of slim ones, but enterprises of this sort are like neoplasms (benign of course), or embryos waiting to be born, and when they can find a suitable home there is no stopping their growth. Before my collaborators and I had been very long at work it became clear that there was not one question, but two. Not only why modern science originated only in Europe, but why, during the previous fifteen centuries, China had been much more advanced in science and technology than the cultures of the West. I cannot venture on any answer to these questions here because I want to talk about that other question. How far has there been real continuity?

My collaborators and I have all along assumed that there is only one unitary science of Nature, approached more or less closely, built up more or less successfully and continuously, by various groups of mankind from time to time. This means that one can expect to trace an absolute continuity between the first beginnings of astronomy and medicine in Ancient Babylonia, through the advancing natural knowledge of mediaeval China, India and the classical world, to the break-through of late Renaissance Europe when, as has been said, the most effective method of discovery was itself discovered. Many people probably share this point of view, but there is another one which I may associate with the name of Oswald Spengler, the German world-historian of the '30s, whose works, especially "The Decline of the West", achieved much popularity for a time. According to him, the sciences produced by different civilizations were like separate and irreconcilable works of art, valid only within their own frames of reference, and not subsumable into a single history and a single ever-growing structure. Anyone who has felt the influence of Spengler retains, I think, some respect for the picture he drew of the rise and fall of particular civilizations and cultures, resembling the birth, flourishing and decay of individual biological organisms, in human or animal life-cycles. Certainly I could not refuse all sympathy for a point of view so like that of the Taoists, who always emphasised the cycles of life and death in Nature; yet while one can easily see that art styles, religious ceremonies, or different kinds of music tend to be incommensurable, for mathematics, science and technology the case is altered – man has always lived in an environment essentially constant, and his knowledge of it, if true, must therefore tend towards a constant structure.

This point would not perhaps need emphasis if certain scholars, in their anxiety to do justice to the differences between the ancient Egyptian or the mediaeval Chinese, Arabic or Indian world-views and our own, were not inclined to follow lines of thought which might lead to Spenglerian pessimism. Pessimism I say, because of course he did prophesy the decline and fall of our own scientific civilization. Thus, to take one example, my own collaborator, Nathan Sivin, a brilliant investigator of mediaeval Chinese astronomy and alchemy, has rightly pointed out that for traditional China "biology" was not a separated and defined science. One gets its ideas and facts from philosophical writings, books on pharmaceutical natural history, treatises on agriculture and horticulture, monographs on groups of natural objects, miscellaneous memoranda and so on. He urged that to speak of "Chinese biology" would be to imply a structure which historically did not exist, disregarding mental patterns which did exist. Taking such artificial rubrics seriously would also imply the natural but perhaps erroneous assumption that mediaeval Chinese scientists were asking the same questions about the living world as their modern counterparts in the West, and simply happened through some quirk of national character, language, economics, scientific method or social structure, to find different answers. On this approach it would not occur to one to investigate what questions the ancient and mediaeval Chinese scientists themselves were under the impression that they were asking. A fruitful comparative history of science would have to be founded not on the counting up of isolated discoveries, insights or skills meaningful for us now, but upon "the confrontation of integral complexes of ideas with their interrelations and articulations intact". These complexes could be kept in one piece only if the problems which they were meant to solve were understood. Chinese science must, in other words, be seen as developing out of one state of theoretical understanding into another, rather than as any kind of abortive development towards modern science.

All this was well put; of course one must not see in traditional Chinese science simply a "failed prototype" of modern science, but the formulation here has surely to be extremely careful. The danger is of falling into the other extreme, of denying the fundamental continuity and universality of all science. This could be to resurrect the Spenglerian conception of the natural sciences of the various dead (or even worse, the living) non-European civilizations as totally separate, immiscible thought-patterns, more like distinct works of art than anything else, a series of different views of the natural world irreconcilable and unconnected. Such a view might be used as the cloak of a historical racialism, the sciences of pre-modern times and the non-European cultures being thought of as wholly conditioned ethnically, and rigidly confined to their own spheres, not part of humanity's broad onward march. Moreover it would leave little room for those actions and reactions that we are constantly encountering, deep-seated influences which one civilisation had upon another.

In another place Nathan Sivin has written: "The question of why China never spontaneously experienced the equivalent of our scientific revolution lies of course very close to the core of a comparative history of science. My point is that it is an utter waste of time, and distracting as well, to expect any answer until the Chinese tradition has been adequately comprehended from the inside." The matter could not be better put; we must of course learn to see instinctively through the eyes of those who thought in terms of the Yin and Yang, the Five Elements, the symbolic correlations, and the trigrams and hexagrams of the "Book of Changes". But here again this formulation suggests a purely internalist ideological explanation for the failure of modern natural science to arise in Chinese culture. I do not think that in the last resort we shall be able to appeal primarily to inhibiting factors inherent in the Chinese thought-world considered as an isolated Spenglerian cell. One must always expect that some of these intellectual limiting factors will be identifiable, but for my part I remain sceptical that there are many factors of this kind which could not have been overcome if the social and economic conditions had been favourable for the development of modern science in China. It may indeed be true that the modern forms of science which would then have developed would have been rather different from those which actually did develop in the West, or in a different order, but of that one cannot be sure. There was, for example, the lack of Euclidean geometry and Ptolemaic planetary astronomy in China, but China had done all the ground-work in the study of magnetic phenomena, an essential precursor of later electrical science; and Chinese culture was permeated by conceptions much more organic, less mechanistic, than that of the West. Moreover Chinese culture alone provided that materialist conception of the elixir of life which, passing to Europe through the Arabs, led to the macrobiotic optimism of Roger Bacon and the iatro-chemical revolution of Paracelsus, hardly less important in the origins of modern science than the work of Galileo and Newton. Whatever the ideological inhibiting factors in the Chinese thought-world may turn out to have been, the certainty always remains that the specific social and economic features of traditional China were connected with them. They were clearly part of that particular pattern, and in these matters one always has to think in terms of a "package-deal". In just the same way, of course, it is impossible to separate the scientific achievements of the Ancient Greeks from the fact that they developed in mercantile, maritime, city-state democracies.

A similar problem has of late been taken up by Said Husain Nasr, the Persian scholar who is making valuable contributions to the history of science in Islam. He, for his part, faces the failure of Arabic civilization to produce modern science. But far from regretting this he makes a positive virtue of it, rejecting belief in any integral, social-evolutionary development of science. Opening one of his recent books* you read as follows: "The history of science is often regarded today as the progressive accumulation of techniques and the refinement of quantitative methods in the study of Nature. Such a point of view considers the present conception of science to be the only valid one; it therefore judges the sciences of other civilisations in the light of modern science and evaluates them primarily with respect to their 'development' with the passage of time. Our aim in this work however, is not to examine the Islamic sciences from the point of view of modern science and of this 'evolutionist' conception of history; it is on the contrary to present certain aspects of the Islamic sciences as seen from the Islamic point of view."

Now Nasr considers that the Sufis and the universal philosophers of mediaeval Islam sought and found a kind of mystical *gnosis*, or

* *Science and Civilisation in Islam.*

cosmic *sapientia*, in which all the sciences "knew their place", as it were (like servitors in some great house of old), and ministered to mystical theology as the highest form of human experience. In Islam, then, the philosophy of divinity was indeed the *regina scientiarum*. Anyone with my attachment to theology as well as science cannot help sympathising to some extent with this point of view, but it does have two fatal drawbacks, it denies the equality of the forms of human experience, and it divorces Islamic natural science from the grand onward-going movement of the natural science of all humanity. Nasr objects to judging mediaeval science by its outward "usefulness" alone. He writes: "However important its uses may have been in calendrical computation, in irrigation or in architecture, its ultimate aim always was to relate the corporeal world to its basic spiritual principle through the knowledge of those symbols which unite the various orders of reality. It can only be understood, and should only be judged, in terms of its own aims and its own perspectives." I demur. It was part, I would maintain, of all human scientific enterprise, in which there is neither Greek nor Jew, neither Jain nor Muslim. "Parthians, Medes and Elamites, and the dwellers in Mesopotamia, and in Judaea and Cappadocia . . . and the parts of Libya about Cyrene, we do hear them speak in our tongues the marvellous works of God."

The denial of the equality of the forms of human experience comes out very clearly in another work of Said Husain Nasr also much to be recommended.* Perhaps rather underestimating the traditional high valuation placed within Christendom upon Nature – "that other Book", as Sir Thomas Browne said, "which lies expans'd unto the eyes of all" – he sees in the scientific revolution a fundamental desacralisation of Nature, and urges that only by reconsecrating it, as it were, in the interests of an essentially religious world-view, will mankind be enabled to save itself from otherwise inevitable doom. If the rise of modern science within the bosom of Christendom alone had any causal connections with Christian thought that would give it a bad mark in his view. "The main reason why modern science never arose in China or Islam", he says, "is precisely because of the presence of a metaphysical doctrine and a traditional religious structure which refused to make a profane thing of Nature. . . . Neither in Islam, nor India nor the

* *The Encounter of Man and Nature.*

Far East, was the substance and the stuff of Nature so depleted of a sacramental and spiritual character, nor was the intellectual dimension of these traditions so enfeebled as to enable a purely secular science of Nature and a secular philosophy to develop outside the matrix of the traditional intellectual orthodoxy. . . . The fact that modern science did not develop in Islam is not a sign of decadence (or incapacity) as some have claimed, but of the refusal of Islam to consider any form of knowledge as purely secular and divorced from what it considers the ultimate goal of human existence". These are striking words, but are they not tantamount to saying that only in Europe did the clear differentiation of the forms of experience arise? In other words Nasr looks for the synthesis of the forms of experience in the re-creation of a mediaeval world-view, dominated by religion, not in the existential activity of individual human beings dominated by ethics. That would be going back, and there is no going back. The scientist must work *as if* Nature was "profane". As Giorgio di Santillana has said: "Copernicus and Kepler believed in cosmic vision as much as any Muslim ever did, but when they had to face the 'moment of truth' they chose a road which was apparently not that of *sapientia;* they felt they had to state what appeared to be the case, and that on the whole it would be more respectful of divine wisdom to act thus." And perhaps it is a sign of the weakness of what I must call so reactionary a conception that Nasr is driven to reject the whole of evolutionary fact and theory, both cosmic, biological and sociological.

In meditating on the view of modern physical science as a "desacralisation of Nature" many ideas and possibilities come into the mind, but one very obvious cause for surprise is that it occurred in Christendom, the home of a religion in which an incarnation had sanctified the material world, while it did not occur in Islam, a culture which had never developed such an incarnation belief. This circumstance might offer a telling argument in favour of the primacy of social and economic factors in the break-through of the scientific revolution. It may be that while ideological, philosophical and theological differences are never to be undervalued, what mattered most of all were the facilitating pressures of the transition from feudalism to mercantile and then industrial capitalism, pressures which did not effectively operate in any culture other than that of Western, Frankish, Europe.

In another place Nasr wonders what Ibn al-Haitham or al-Bīrūnī or al-Khāzinī would have thought about modern science. He concludes that they would be amazed at the position which exact quantitative knowledge has come to occupy today. They would not understand it because for them all *scientia* was subordinated to *sapientia*. Their quantitative science was only one interpretation of a segment of Nature, not the means of understanding all of it. "'Progressive' science", he says, "which in the Islamic world has always remained secondary, has now in the West become nearly everything, while the immutable and 'non-progressive' science or wisdom which was then primary, has now been reduced to almost nothing." It happened that I read these words at a terrible moment in history. If there were any weight in the criticism of the modern scientific world-view from the standpoint of Nasr's perennial Muslim *sapientia* it would surely be that modern science and the technology which it has generated has far outstripped morality in the Western and modern world, and we shudder to think that man may not be able to control it. In fact no human society of the past ever was able to control technology, but they were not faced by the devastating possibilities of today, and the moment I read Nasr's words was just after the Jordanian civil war of last September, that dreadful fratricidal catastrophe within the bosom of Islam itself. *Sapientia* did not prevent it, nor would it seem, from the historical point of view, that wars and cruelties of all kinds have been much less within the realm of Islam than that of Christendom. Something new is therefore needed to make the world safe for mankind, and I believe that it can and will be found.

In later discussions Nathan Sivin makes it clear that he is just as committed to a universal comparative history of science as any of the rest of us. That would be the ultimate justification of all our work. His point is not that the Chinese (or Indian, or Arabic) tradition should be evaluated only in the light of its own world-view, then being left as a kind of museum set piece, but that it must be understood as fully as possible in the light of this as a prelude to the making of wide-ranging comparisons. The really informative comparisons, he suggests, are not those between isolated discoveries, but between those whole systems of thought which have served as the matrices of discovery. One might therefore agree that not only particular individual anticipations of modern scientific discoveries are of interest as showing the slow development of human natural knowledge, but also that we need to work out exactly how the world-views and scientific philosophy of mediaeval China, Islam or India, differed from those of modern science. Each one is clearly of great interest not only in itself but in its relation to the idea-system of modern science. In this way we would not only salute the Chinese recording of sun-spots from the 1st century B.C. or the first correct explanation of the optics of the rainbow by Qutub al-Dīn al-Shīrāzī in 1300 A.D. as distinct steps on the way to modern science, but also take care to examine the cosmologies and philosophies within which such steps were made, to see exactly how and where they were different from each other and from that of modern science. And this not to condemn them for being different, but to see without prejudices what their character really was.

For example, there could be advantages and disadvantages. The polar equatorial system of Chinese astronomy delayed Yü Hsi's recognition of the precession of the equinoxes by six centuries after Hipparchus, but on the other hand it gave to Su Sung an equal priority of time over Robert Hooke in the first application of a clock-drive to an observational instrument; and the mechanisation of a demonstrational one by I-Hsing and Liang Ling-Tsan was no less than a thousand years ahead of George Graham and Thomas Tompion with their orrery of 1706.

The only danger of the conception of human continuity and solidarity, as I have outlined it, is that it is very easy to take modern science as the last word, and to judge everything in the past solely in the light of it. This has been justly castigated by Joseph Agassi, who in his lively monograph on the historiography of science satirises the mere "re-arranging of up-to-date science textbooks in chronological order", and the awarding of black and white marks to the scientific men of the past in accordance with the extent to which their discoveries still form part of the corpus of modern knowledge.* Of course this Baconian or inductivist way of writing the history of science never did justice to the "dark side" of Harvey and Newton, let alone Paracelsus, that realm of Hermetic inspirations and idea-sources which can only be regained by us with great difficulty, yet is so important for the history of thought, as the life-work of Walter Pagel has shown. One can see immediately that this difficulty is even greater in the case of non-European civilisa-

* *Towards a Historiography of Science.*

tions, since their thought-world has been even more unfamiliar. Not only so, but the corpus of modern knowledge is changing and increasing every day, and we cannot foresee at all what its aspect will be a century from now. Fellows of the Royal Society like to speak of the "true knowledge of natural phenomena", but no one knows better than they do how provisional this knowledge is. It is neither independent of the accidents of Western European history, nor is it a final court of appeal for the eschatological judgment of the value of past scientific discoveries, either in West or East. But it is the best guide we have.

My collaborators and I have long been accustomed to use the image of the ancient and mediaeval sciences of all the peoples and cultures as rivers flowing into the ocean of modern science. In the words of the old Chinese saying: "the Rivers pay court to the Sea". In the main this is indubitably right. But there is room for a great deal of difference of opinion on how the process has happened and how it will proceed. One might think of the Chinese and Western traditions (as Nathan Sivin has said) travelling substantially the same path towards the science of today, that science against which, on the inductivist view, all ancient systems can be measured. But on the other hand they might have followed, and be following, rather separate paths, the true merging of which lies well in the future. Undoubtedly among the sciences this point of fusion varies. In astronomy and mathematics it took but a short time, in the seventeenth century; in botany and chemistry the process was much slower, not being complete until now, and in medicine it has not happened yet. Modern science is not standing still, and who can say how far either the biology or the physics of the future will have to adopt conceptions much more organicist than the atomic and the mechanist which have so far prevailed? Who knows what further developments of the psychosomatic conception in medicine future advances may necessitate? In all such ways the thought-complex of traditional Chinese science may yet have a much greater part to play in the final state of all science than might be admitted if science today was all that science will ever be. Always we must remember that things are more complex than they seem, and that wisdom was not born with us. To write the history of science we have to take modern science as our yardstick – that is the only thing we can do – but modern science will change, and the end is not yet. Here as it turns out is yet another reason for viewing the whole march of humanity in the study of Nature as one single enterprise.

Time and the Ancient Monuments

Hilda Ellis Davidson

The publication of a number of papers by Colin Renfrew[1] on new theories of dating finds and monuments of the prehistoric period, together with the appearance this year of a second book by Professor Thom[2] and his participation in a recent *Chronicle* programme on television, have aroused much interest. They coincide with an increasing wave of ardent map-reading in search of clues to ancient knowledge, based on the distribution of natural features and early monuments and sites. The problems with which Renfrew and Thom are dealing are fundamentally technical ones, but like other questions which have wider implications and possible connections with religion and occult lore, certain facets have been oversimplified and joyfully seized on by a lunatic fringe. It is therefore important to take a long cool look at what evidence we have before conclusions are drawn.

When a piece of early pottery, or a metal brooch, is found by chance in the earth, we expect the archaeologist to tell us what it is, and to give us a date for it. He sets about this, first, on the basis of his experience; he has studied different types of Neolithic pottery in the area, and knows how it differs from that of the Bronze Age, or of later periods up to the medieval; he has seen many brooches in museums if he has not uncovered such objects himself. But how about the dating? A coin, say, of Justinian, is easy: we have historical evidence for his dates. Romano-British and Anglo-Saxon brooches belong inside fairly limited periods, and we have historical pegs on which to hang their dating also; moreover such quantities of these have been found that they have been studied and discussed in great detail. When the object is part of a larger complex, such as a hoard, cemetery or dwelling site, the dating can be further checked by setting one object against another. There may be additional clues, as in the excavation of the wooden quay at Bergen in Norway, which goes back to early medieval times; a section in the soil reveals a

[1] *The Listener* 84 (31 Dec. 1970) 897; 85 (7 Jan. 1971) 12; 'The Tree-Ring Calibration of Radiocarbon'; *Proc. Prehist. Soc.* 36 (1970) 280–311, which gives a list of other papers on this subject.

[2] *Megalithic Lunar Observatories* (Oxford 1971).

series of dark lines at intervals, which are the traces of fires when the wharves have burnt down in the past, and the dates of these fires are known. We have therefore a clear indication of the approximate date of finds at different points in the section, and even without this useful pointer, the levels of finds carefully recorded is of great value in establishing relative chronology. But what of the odd piece of Neolithic pottery turned up by the plough, or some isolated megolithic grave above the surface of the earth, with the contents long vanished from the stone burial chamber? The user of the pot and the builder of the grave lived long before the time of historical record or dateable historic events.

The first man to establish the idea of a relative chronology for early finds from the prehistoric period was Sir Isaac Newton, about 1690[3]. He set information from ancient literature (which for him meant the classics and the Bible) on an absolute calendrical basis. His knowledge of astronomy enabled him to note the position of the stars, mentioned for instance in the account of the voyage of the Argonauts, and to compare this with the position which they occupied in his own time; his knowledge was perforce limited compared with that of astonomers today, but it gave him a rough approximation. He was aware of the importance of bringing together scientific, historical and literary knowledge; indeed he was fortunate in that at the close of the seventeenth century these had not yet drifted apart as they have done in our own time.

A great many of our assumptions as to the dates of the pharaohs of Egypt depend on our awareness of one precise astronomical event – the heliacal rising of the star Sirius – which is recorded as taking place in the reign of one of them. Given an event of this kind, dates can be worked out from it in both directions, but these are far more hypothetical and approximate than the textbooks and popular histories indicate. In 1875 Schliemann, that self-made man led by the stories of Homer as by a shining light to transform himself from a grocer's assistant into the discoverer of the lost city of Troy, addressed the Society of Antiquities in London. In the subsequent discussion Gladstone claimed that at last the dense mist covering prehistoric times was becoming transparent, "and the figures of real places, real men, real facts are slowly beginning to reveal to us their outline"[4]. He was alluding primarily to the great

[3] Renfrew, PPS (op. cit.) 281ff.
[4] G. Daniel, *The Idea of Prehistory* (Pelican Bks. 1964) 55.

ruins of the Ancient World and what was being learned of the old civilizations of early Greece, Mesopotomia, Egypt and the Hittites. However a Danish archaeologist, Worsaae, had published as early as 1849 his doctrine of the Three Ages of prehistoric man, the Stone Age, the Bronze Age and the Iron Age; later as finds increased the Stone Age was perforce divided into two, the Palaeolithic and the Neolithic. By 1903 the Swedish archaeologist Montelius had worked out a systematic scheme, dividing up these periods into a number of phases, based on the development of certain tools and weapons (such as the axe and the dagger) from various regions in Europe, compared with those found in the occupation levels of Troy. Flinders Petrie, the English archaeologist, went further, basing his data on the exchange of goods between different areas; for example a piece of dateable Egyptian painted pottery found in Crete would mean that objects found with it were used at the same time. He also put finds from predynastic cemeteries in Egypt in chronological order, and used an arbitrary date sequence for his lists.

The early Scandinavians, Worsaae and Thomsen, had never suggested that the Stone Age automatically developed into the Bronze Age without outside influences; they thought that the transition from stone to bronze was probably the result of the arrival of a new group of people with new skills. However, in the nineteenth century much work published depended on one main assumption, that early man evolved steadily from ignorance and stupidity to a more informed technology and greater wisdom and understanding. In a guide to the archaeological collections in the Paris Exposition of 1867 the lessons to be learnt from the prehistoric finds were summarized in capitals thus: LOI DU PROGRÈS DE L'HUMANITÉ; LOI DU DEVELOPPEMENT SIMILAIRE; HAUTE ANTIQUITÉ DE L'HOMME. This echoed the declaration of Herbert Spencer a little earlier: "Progress is not an accident but a necessity. It is a fact of nature."

This assumption did not survive the First World War. Indeed it is doubtful whether it was ever as widespread among thinking people as we tend now to believe. It had been recognized as least as early as the 1870's that there could be retrogression in the history of a people as well as progress: "Reversion ever dragging evolution in the mud", as Tennyson expressed in 1886.[5] The discovery in Spain in 1880 of superb cave paintings from the palaeolithic period

[5] *Locksley Hall Sixty Years After.*

and subsequent discoveries in the Dordogne finally brought scholars to realize (reluctantly) that these magnificent works of art had been produced by the ignorant savages who lived many thousands of years before Christ. Dramatic finds like the treasures from Tutankhamen's tomb, which dominated the newspapers for weeks in the 1920's and produced a whole folklore at popular level, all helped to make man aware of the startling achievements of the early centuries. Discoveries multiplied at a staggering rate as experience and scientific methods of excavation increased, and it became evident that the position was far more complex and untidy than the early scholars had imagined. There were now no longer merely the peoples of the classical world and the Bible to deal with; there were also the problems of the impressive remains from the Americas which showed that early civilization had existed there also. It became apparent that the same cultural features, megalithic stone tombs, metal-working, calendars, and cities appeared in widely separated areas, and there was unending argument as to whether these could have evolved separately and developed independently or whether the knowledge behind them was brought from one area to another by traders, travellers and migrating groups. The early Scandinavian archaeologists had recognised both possibilities, and they are after all not wholly incompatible, but at the close of the nineteenth century the longing for a simple, uncomplicated answer began to produce fanatics and fantasies on both sides.

One of the chief contributors to the controversy was Elliot Smith, a research fellow of St. John's, Cambridge, who became the first professor of Anatomy at Cairo University. There he became involved in the study of Egyptology and in particular of mummification and the study of ancient remains from the cemeteries. He became convinced that so complicated a technique as embalming must have originated from Egypt and could never have been rediscovered elsewhere. Until his death in 1937 he preached the diffusion of culture with Egypt as its creative centre, which included the theory that all megalithic building was derived from the knowledge possessed by the builders of the pyramids. He and W. J. Perry, a colleague of his in University College, London, believed that a series of world travellers seeking the elixir of life set out from Egypt into an uncivilized world peopled by ignorant savages, taking the secrets of stone-building and the like with them. In their enthusiasm for this romantic notion they gradually abandoned all links with the scientific use of evidence, and the academic theory became a superstition, followed with religious intensity. Lord Raglan supported them by his assumption: "No invention, discovery, belief or even story is known for certain to have originated in two separate cultures"[6], although for him the centre of the civilizing inspiration shifted to Mesopotomia instead of Egypt. Those of us whose education began between the wars have been brought up with this assumption in the background, although in a more moderate form. Out of this muddled area of thinking, romanticizing of the distant past, and neurotic desire for one simple, unqualified answer, were born the theories of the significance of the measurements of the Great Pyramid, of the Lost Tribes of Israel, and the Ancient Druids. Such theories, so amusing a generation or two later, so that undergraduate audiences explode into mirth when quotations from the old authorities are read to them, were the exciting, stimulating doctrines of their own time, fascinating the predecessors of these same students, who in their turn mocked at the limitations of the Victorians. Once archaeological knowledge increased, so that it was not easy for the untrained reader to check the data put forward with such apparent assurance, the position was like that described by Trevor-Roper, in discussing the fantasies engendered by the witch-hunting of the sixteenth century:

> "Laymen might not accept all the esoteric details supplied by the experts, but they accepted the general truth of the theory, and because they accepted the general truth they were unable to argue against its more learned interpreters."
>
> (*European Witch-craze of the 16th and 17th centuries*, 1969, p. 18.)

The fierce battles raging between the experts themselves as to method and interpretation in archaeological work were, like the quarrels of the gods on Mount Olympus, beyond the ken of the ordinary man.

Not that all diffusion theories were based on a picture of megalithic missionaries carrying civilization to the outer wastes of the continent of Europe. Gordon Childe, whose famous *Dawn of Civilization* was first published in 1925 and ran into its sixth edition in 1957, slowly put forward a modified diffusionism, built up on detailed examination of many different cultures in many different parts of the world which influenced one another. This is a cautious, rational approach, avoiding wild conclusions based on surface resemblances. But Childe still assumed that the beginning of civilization in Europe came from the Near East: "Whichever chronology

[6] Lord Raglan, *How Came Civilization?* (1939) 15.

is eventually vindicated, the primacy of the Orient remains unchallenged", he declared in the last edition of this work. Childe's findings have been standard archaeological theory for many years.

This continued even after the astonishing discovery of Carbon 14 dating, put forward by a physicist, W. F. Libby of Chicago, in 1946[7]. This is based on the presence in organic matter of radioactive carbon, an isotope of ordinary carbon (C^{12}), of atomic weight 14 (C^{14}). The proportion of radiocarbon in living vegetation and living animals is effectively the same as that in the carbon dioxide of the atmosphere. After the death of an organism no further radiocarbon is added, and that present disintegrates at a regular rate, so that after 5,700 years approximately half the original amount is left, and after 11,400 years, a quarter. To discover the age of a piece of wood or other organic material, a sample of about an ounce is burnt to give carbon dioxide, and the gas then purified and reduced to pure carbon, which is spread over the surface of a Geiger counter. The proportion of radiocarbon should give the approximate age of the sample. In his description of this method in 1958, Zeuner warned his readers of the number of technical difficulties involved in its use, and made it clear that the dating was by no means precise; an accurately dated piece of peat gave a result when tested by the C14 method about 1000 years below its estimated age (probably because of contamination by younger humus matter). An obvious disadvantage to the archaeologist is the necessity of destroying a portion of the object tested, while in the case of large beams used in ships or buildings, the wood may have been reused, or an outer growth layer been lost. Since 1958 considerable progress has been made, but at the Nobel Symposium held at Uppsala in 1968 which reviewed the results of twenty years work, it was emphasised that radiocarbon dating needs to be checked by other chronologies.[8] Four possible means of doing this are now available. First, that of dendrochronology, the counting of tree-rings from the bristle-cone pine of California, where trees are found with dead wood going back as far as 5150 B.C., and the amount of error in calculating years is negligible. Secondly, that of varve analysis, the counting of yearly deposits of melting ice on varve-clay in certain areas of Europe and America; this is a less precise method, but reaches to a more remote past than that of the tree-rings, going back at least 12,000 years. Organic matter from

[7] F. E. Zeuner, *Dating the Past* (4th. edition 1958) 341ff.

[8] E. Neustupny, 'A New Epoch in Radiocarbon Dating', *Antiquity* 44 (1970) 38–45.

the trees and the deposits are tested by the Carbon 14 method and this provides a check on its accuracy. Thirdly there is a thermoluminescence dating, a useful technique quite independent of radiocarbon dating, although its accuracy at present is claimed to be only 10 per cent[9]. It depends on the fact that radiation from traces of radioactive elements in pottery bombards other constituents in the clay and raises electrons to metastable level. The firing of a pot in ancient times supplied enough additional energy to enable each electron to fall back to its stable position and to emit a photon of light. When a fragment of pot is reheated, the amount of thermoluminescence represents the accumulated radiation damage since the original firing, and hence the amount of time which has elapsed since the pot was made. The earlier the pot, the greater should be the amount of light emission. However the composition of clays and other earth materials and the contribution from radioactive elements in the soil have also to be taken into account, and such a method would be of little use alone. Its advantage is that pottery fragments are usually included in archaeological finds from as early as 7000 B.C., so that it forms a useful check on other means of dating. Fourthly, we have the old familiar method of historical chronology, which goes back as far as the early third millennium B.C. In our increasing preoccupation with scientific techniques, the gap between archaeology and classical/oriental studies has widened, and linguistic evidence has tended to be ignored. The importance of this is now being increasingly realised.

It is important to understand that radiocarbon dating gives a relative chronology only at best, analogous in some ways to Petrie's arbitrary sequence of dates given to early finds from Egypt. There is considerable margin for error in all the scientific methods, as is clear if one consults the technical literature on the subject. It has recently been found, by checking with other means of dating, that radiocarbon results become increasingly distorted with age, and also that there are variations between the northern and southern hemispheres. In fact there is no simple, automatic method of dating artifacts; we win our knowledge of these techniques slowly and painfully, making many mistakes on the way, and may have to jettison many results and theories as new knowledge comes to light. At present it seems as if dates earlier than 2000 B.C. obtained by

[9] E. K. Ralph and M. C. Haes, 'Potential of Thermoluminescence', *World Archaeology* I (1969) 157–69.

radiocarbon dating need to be extended by about 700 years. This is not an enormous stretch of time, considering prehistory as a whole, but the discovery leads to startling conclusions. The old theory that civilization spread from the Near East to Western Europe becomes no longer tenable.

The new findings show striking divergencies in dating monuments from the megalithic period in three main areas, those of the western Mediterranean, Wessex, and S.E. Europe. They have not greatly affected our figures for the dating of the Aegean and European Bronze Age, estimated to have begun about 1800 B.C., but they have pushed the Neolithic period further back, by several thousands of years. It is now thought that the stone temples of Malta should be dated about 3100 B.C. instead of 2340 B.C., while megalithic tombs in Spain are earlier than collective burials in the Aegean area, and also earlier than the pyramids. So also are the great megalithic tombs of France and the British Isles; some of those in France must be dated before 4000 B.C., and the superb tomb of New Grange in Ireland earlier than 3000 B.C. Silbury Hill was apparently raised before the pyramids, and Stonehenge before Mycenae, while metal-working was practised in Central Europe earlier than in Greece.

These conclusions are not going to do violence to any historic interpretations. Our determination to put the western monuments later than those in the Mediterranean area and the Near East were not based on definite evidence, but a result of the theory of diffusion. The earlier archaeologists, arguing from historical chronology only, tended to adopt a rather slower period for development than did the first archaeologists to use the radiocarbon results, and Childe had made it clear that any absolute dating before 3000 B.C. depended on our theories of diffusion, and of the time lag and cultural lag involved[10]. It must be realised that careful examination of any one new site can drastically alter our preconceptions about the development of early man. The excavations of Kathleen Kenyon at Jericho revealed that a city existed there, outside the favoured realms of Egypt and Mesopotomia, as early as the seventh century B.C. That of the village of Lepenski Vir in Yugoslavia has shown that hunting and fishing people lived in a settled community beside the Danube without agriculture or domestic animals other than the dog, carving remarkable sculptures in rounded stone, the earliest statues yet

[10] H. L. Thomas and R. W. Ehrich, 'Some Problems in Chronology', *World Archaeology* I (1969) 145.

known. This makes us revise our rule that village life began when hunters and fishers gave up the nomadic life to practise agriculture and domesticate flocks and herds.

Clearly our work on chronology is not finished; we may assume that it has hardly begun. If we talk too wildly about a "revolution in prehistory" we may become as absurd as the extreme diffusionists now appear. But all that has emerged so far points increasingly to the variety and inventiveness of early man, his ability to adapt to his environment and to create impressive works of building and art when very simple mechanical means only were available. It seems that discoveries and developments were not sudden and immediate, and something which happened once only, like a fundamentalist view of the creation of the world. Rather man's inventive powers, developing much earlier than was formerly realised, have resulted in a multitude of separate discoveries and insights, some of which have been brought to fruition by countless nameless and forgotten individuals. The sudden flowering of a rich culture in one particular region, due sometimes, but not invariably, to stimuli coming in from outside, comes about when men in some given social environment are ready for it, and this birth of a culture and its ultimate decline and decay has happened many times. The ingenuity of the mind of early man, and his patience and skill in developing his ideas about the natural world around him, is illustrated by the recent work of Alexander Thom.

For many years now he and his son, Dr. A. S. Thom, have been patiently measuring and examining the standing stones of the British Isles, particularly such circles and rows of stones as have survived from the megalithic period. In his two books, *Megalithic Sites in Britain* (1967) and *Megalithic Lunar Observatories* (1971) he puts forward a theory impressively supported by detailed evidence. He claims that megalithic man, before 3000 B.C., was a competent engineer. He could transport and erect blocks of stone up to 50 tons in weight and out of them form rings of various shapes, circles, ovals, elipses and so on. The measurements necessitated in constructing these show considerable knowledge of practical geometry, using the 3,4,5 right-angled triangle and other combinations used in trigonometry. Cup and ring markings on rocks show a similar use of geometry on a small scale, and must have been made with beam compasses which could give considerable accuracy. Megalithic man also knew how to use levers, fulcrums, sheerlegs, strings and ropes, to make accurate measuring rods, to use a horizontal baseline for measuring the distance to an object like a modern surveyor, and to "range in" a straight line between two mutually invisible points. Thom claims that the builders of the megalithic monuments used a precise unit of length of 2.72 ft. (the "megalithic yard").

The implication of the sites is that a precise calendar was in use, depending on the movement of the sun and constantly checked. The further north one is, the easier it is to mark a given day in the year by establishing a foresight for the setting sun, and this explains why so many of these solar observatories, as they are claimed to be, were erected in the British Isles and particularly in Scotland[11]. In Argyllshire for instance the conditions are ideal, a mountain region with islands and long views out to sea, so that changes in the sun's position can be viewed against prominent landmarks. Moreover in Scotland the range of the setting point is twice as great as in tropical countries. In such an area early man must have used small boats for fishing and travel, and this would train him in the observation of natural landmarks, and also of tides and currents. It may have been a result of observing the latter that led prehistoric man in Scotland to take an interest in the movements of the moon.

In his recent book Thom claims a number of sites as lunar observatories, based on skilful use of natural foresights. Others, less accurate, have an arrangement of stones to indicate the rising and setting points of the moon. There are lunar backsights marked by tall stones, and he believes that most of the more impressive alignments in Britain so far examined are lunar ones. To create such sites, years of patient work must have gone to the fixing of a backsight in the correct position. To begin with, the observer had to stand so that the waning moon grazed a distant foresight. As it did so, he had to make the final adjustments to his own position, to get exact contact between one of his limbs and a definite point on the hill or rock or whatever he was using as a foresight, and at this place he would fix a rod. This process had to be repeated on many nights when the moon was visible. It runs through its cycle of changes of position in a month instead of a year, so that the daily change is greater than that of the sun, and the northerly and southerly limits of the rising and setting positions themselves change over a cycle

[11] Review of Thom's book in *The Listener* by Euan Mackie, 85 (28 Jan. 1971) 120.

of 18.61 years. Further fluctuation is caused by the effect of the sun's attraction, and if this is detected it is possible to indicate the time of an eclipse. Thom has suggested that the makers of these sites used a series of stakes to mark successive setting positions, like a graph drawn on the ground, and that perhaps the fan-shaped settings of stones in Caithness were used in such a way.

He emphasises the fact that this is only a beginning to a rich and rewarding study, and that it is essential that all standing stones should be preserved as far as possible in their true positions. His findings so far seem impressive; if they are correct, they must add to our knowledge of early man and our respect for his intellectual achievement. Such constructions show an admirable use of observation backed up by patient research as early as the fourth millenium B.C. in the British Isles. In the same way the excavation of Silbury Hill revealed a capacity for planning and organization on a large scale at a surprisingly early date. It is the more convincing that we need not assume any supernatural skill or wisdom on the part of the builders and planners; given keen intelligence and time and opportunity to use their minds, such work was within the powers of men of that early period. That the use of the calendar to relate the changing seasons to the movements of sun and moon were linked to early religious ritual, and to the symbolism of divine beings of sky and earth, is very probable, but of this we know nothing definite as yet. It is conceivable also that an intellectual élite were in possession of this esoteric knowledge, which was passed on through special education and long training, such as the shaman receives among nomadic peoples. An interesting question is how long this special knowledge may have been preserved in North-Western Europe, and over how wide a region? Einar Pálsson has been working for years on a somewhat similar arrangement of sites and landmarks to form a calendar in Iceland, where the same promising conditions for observation and landmarks prevail as in northern Scotland, but where no settlement was made until the ninth century A.D.[12]

Professor Thom's figures are the result of years of careful work, and their accuracy may be checked. Unfortunately the same cannot be said for the figures in other publications on astro-archaeology and the like, now multiplying at an alarming rate. There have been protests from the Editor of *Antiquity* against the publication of Lyle

[12] *Tru og Landnám* (Reykjavik 1970), (the second book of a series).

Borst[13], the Professor of Physics and Astronomy at the State University of New York at Buffalo, who finds under any Christian site he visits what he claims as a megalithic floor-plan; he gives no really convincing evidence for these assumptions, because neither his references nor his measurements are satisfactory. Nevertheless his findings have received wide publicity through *Science*, *Nature* and the B.B.C. In Professor Borst's article in *Nature* (224 (Oct. 25, 1969) 335–42) on English Henge Cathedrals, the type of argument used is reminiscent of those once employed to prove the allegorical significance of the measurements of the Great Pyramid, or the wilder theories of Margaret Murray as to the sacrifice of divine kings in England down to Stuart times: that is, he deliberately selects what he wants from a very large number of measurements and shapes; indeed he goes even further than this, and forces the facts into shape if they do not quite fit. Apart from such statements as the following: "A few irregularly spaced holes have been omitted"; "The height (and nature) of the original structure is conjectural, but oak boles 70ft. long (21m.) are found in the fens of Cambridgeshire and Norfolk" (an amazing *non-sequitur*); his method of using evidence may be illustrated by his claims for the megalithic plan of a little church built inside an ancient earthwork. His megalithic plans have depended on the position of side-chapels, and this particular church has none, but he is undefeated: "Because the church lacks side chapels, the identification of the megalithic geometry rests on the fit of the Woodhenge oval. The width of the nave is 14.6ft. (5 megalithic yds. = 13.6ft.), the tower 8.0ft. (3 megalithic yds. = 8.16ft.) and the length of nave and tower, 37.5ft. (14 megalithic yds. = 38.1ft.)". Such logic will only bring conviction by those mesmerised by the mere mention of angles and figures, those who are determined to be convinced at whatever cost, and are not deterred by the fact that none of the measurements exactly correspond. Like Elliot Smith's Children of the Sun, these theories have acted like dragon's teeth; from the soil into which they fall, a host of enthusiastic astro-archaeologists spring to life. We are paying no doubt for the impressive increase in scientific methods used in archaeology; the general public, having watched on TV the apparently miraculous resurrection of Viking Ships from fragments of softened wood in a river bed or heard of the marvels of C14 dating, are conditioned to accept marvels uncritically and leave the

[13] *Antiquity* (1969) 172; (1970) 4–6.

evidence to the experts. In his admirable work on the theories of prehistory. Glyn Daniel quotes from Barraclough: "The history we read, though based on facts, is, strictly speaking, not factual at all, but a series of accepted judgements"[14], and points out that this is even more true of prehistory, where we are always "moving from one set of judgements to another." He raises the question of the significance of prehistory:

> "It cannot be pretended that there is anything approaching a philosophy of prehistory; yet it is precisely in this sphere of the philosophical relevance of prehistory to ourselves that prehistory may have most to contribute to the public."

It is just this, it would seem, that the public are demanding, and it would be a pity if this thirst for relevance and significance in the records of early man should be satisfied only by wild hypotheses and baseless theorizing. To seek entry into a fairy-tale world of ancient seers, without much discipline and labour on our part, is to forswear all that is of value in our intellectual training and to gain only superstition in return for the sacrifice.

[14] G. Daniel, op. cit. 165–66. From G. Barraclough, *History in a Changing World* 14.

Review: The Body (Film)

The makers of *The Body* aimed at presenting a particular view of the body and human life. Tony Garnett, the producer, said that he and his colleagues "saw in this film an opportunity to legitimately encapsulate some of the provisional conclusions we'd come to about the world." Roy Battersby, the director, referring to the people in the film, said, "One wanted to assemble a group which said, 'All human life is here.' " Their advertising slogan runs, "*The Body* is about you and everybody you know." Their brochure claims, "It's an investigation into who, why and what we are." The composition of the film itself, the material and the structure, suggests that the makers were trying to answer the questions, what do things look like that we can't feel, or can only feel? They "speeded up" such things as growing older from the moment we are conceived, where the movement is too slow for us to perceive it, and "slowed down" physical actions where it is too fast; they filmed such things as copulation, digestion, birth. All this has, of course, been done before.

The Body team seemed to be asking a further question, what do things feel like that we can only see? Perhaps because they happen to other people? This became explicit in the conversations with the dying woman and the blind girl; it remained implicit in the unscripted sequences where the people commented spontaneously on their own activity in the film and how they felt about taking off their clothes. The spectator's response was obviously meant to be an appreciation of the sensitive and fearless honesty in these scenes, but the honesty is somehow not quite sensitive or fearless or even intelligent enough. The blind girl ("Of course I mind being blind."), the dying woman, the frank participators in the film, earned one's respect and sympathy but the situations were isolated and limited, they were not so placed in a context as to help "an investigation into who, why or what we are." The short and comparatively reticent sex sequences were ambiguous about love.

The makers of the film did exploit the techniques of juxtaposition in a number of ways. Matched against the close-ups of the landscape of the body were vistas of hills and trees; the inevitable factory chimneys were then shown as a symbol of pollution; matched against the quiet biological processes were sequences shot in a motor factory, with explicit comment reinforcing the message about the inhumanity of the conveyor belt, and implicit comment could perhaps be seen in the interweaving of this complex with queues of pregnant women waiting and being weighed in clinics. But the emphasis here suggests that the team were more at home making a social protest rather than promoting insight into the nature of the human being. Rather obvious use was made of contrast – the activity of the young with the near-immobility of the old or mentally retarded, the agitated whirling of the sperm with the slow maturation of the Graafian follicle, the fat man with the thin woman, the bright orange bath robe with the biologically white one. There were contrasts but few gradations.

In the end the film left the impression that many opportunities for exploration in depth of the possibilities of the human body had been ignored. There seemed to be no operative conception of the hierarchy in the functions of the body. The autonomous nervous system deals with automatic and unconscious reactions to stimuli; much of the film was concerned with this system, which is one to which we need to pay deliberate attention if we want to catch it at work in ourselves – and even then only some of the phenomena come into view. It is possible to feel ourselves blush or go pale, or change our breathing rhythm involuntarily, or go cold if it happens fast enough (otherwise we just notice the result); but we are never directly conscious of the contraction of the pupil of the eye, or of normal digestion. If the film had been able to represent some of the halfway phenomena of which we can be aware if we concentrate, it might have been more possible to regard the remote impersonal happenings in the vast colon and bladder on the screen as the human and intimate revelation which seems to have been intended. This could also have led to the demonstration of interaction between various parts of the body, which could in turn have introduced the possibilities of changing the body for the better and the influence of the mind in all this, from surgery to auto-suggestion. Physiotherapists and osteopaths could have been shown at work, and before and after X-rays used to illustrate the effects of mechanical manipulation, and surely there was no excuse for ignoring Yoga in a film which claimed, "All human life is here."? (The television production, *The Mind of Man*, by contrast, recognised that there are physical facts which may be awkward to fit in with certain points of view but which nevertheless exist.) Where were those bodily actions which require fine co-ordination and judgement? The weight-lifter was the nearest approach. The skills of the factory workers cried out to be made redundant by more efficient machinery.

The film left one with the feeling that the makers had been inhibited by their social philosophy from portraying any kind of physical excellence. They seemed to believe in a brotherhood of man based on materialistic humanism combined with worship of the mediocre. This may explain why there was no skating, dancing, tennis playing, no examples of movement informed by intelligence. There was not even the recognition of the kind of invention and skill which made the film itself possible—the internal photography being the most spectacular. Perhaps the scope of the film excluded this, as the intention was to focus on the body, and instruments whether for work or play are merely extensions of it. But some way should have been found to indicate man's fullest physical capacities; this would have been more to the point than heaping up piles of food to show how much he eats. There is no justification in the film for the exultant words at the end, spoken by Vanessa Redgrave. The climax and conclusion of the film is a birth sequence, but on the evidence of the film, what has the baby got to live for?

Elizabeth Dupre

Sentences*

The religious man is the one who believes that life is about making some kind of journey; the non-religious man is the one who believes that there is no journey to take. The literature of the inward journey abounds with warnings about how easy it is to lose the way, how narrow is the entrance and how difficult the path.

What is the journey and where does it take us? What all the accounts, whatever their origin, have in common in a sense of the terrors to be encountered en route.

There is the terror of darkness and loss, as all that we are familiar with and all that lends us identity is stripped from us. We discover "dark woods" and "dark nights", sloughs of despond, and doubting castles, periods where vision and hope vanish together.

There is the terror of infatuation – the encounter with Circe or the Sirens, in which progress is halted as we lose ourselves among our projections, or we play with death and destruction.

There is the terror of foul and unsuspected monsters to be grappled with. Beowulf symbolically fights beneath the waves in a life and death combat. "The tumbling waves swallowed him up . . . It was not long before the ravening beast, who had lorded it for half a century in the waste of waters, realized that someone from above was exploring the monsters' home. She made a lunge and grabbed the hero with her loathsome claws . . . Swarms of weird beasts assailed him in the depths, pursued him". His sword, proved in many a battle, turns out to be useless in this case. Only a magic sword, one forged especially for giants, "too large for an ordinary man to use in combat" saved him. Those watching the lake from above, seeing the water convulsed and bloodstained, fear that the hero may have been overcome.

Then there is a kind of passive terror – the terror of accepting mortality, weakness, old age. Beowulf, after all his years of triumph, has to let a young hero help him kill his last monster. Gilgamesh, the Sumerian hero, dies, having had the flower of life snatched from him after he had given his life to the quest.

Apart from the struggles of maturity which form the journey, one might say too that there is a kind of pre-journey, and that it is

*** From *Travelling In* by Monica Furlong. Hodder and Stoughton Ltd., 1971. Quoted with acknowledgements to the author, publisher and agents.**

this which childhood, adolescence, and young adulthood are about. Ulysses must prove himself on the plains of Troy before the long journey homeward can begin, and then there is the struggle to get free of Calypso who is, perhaps, the mother. He must be a man before he can embark upon the adventures of a man.

Through what country does the road pass? There must be as many roads as there are people, but certain features seem to recur. There is the pre-journey – the establishment of the identity, through courage, through suffering, through success, through love, through battle, sometimes through the experience of being marked, as by conversion or some kind of vocation. There is the need to get free of the mother.

Then there is the embarkation, preceded either by vision or by disillusion and fear. Once the journey has started there seem to be certain landmarks. There are the terrors already referred to, and the suffering which accompanies them. There is an inner struggle between conflicting drives towards perfection on the one hand and wholeness on the other. There is a search to find a true guilt – not the cheap guilt which evangelists once manipulated, now more usually employed by radical reformers. There is the willingness to give up action when it assumes the comforting properties of a drug. There is the movement towards a state of stillness, and a longing for prayer.

. . . . .

Is it rationalisation to speak also of the gain of growing older? In youth there was shyness and fear towards the opposite sex; neither boy nor girl can quickly make sense of the other's needs. ("Men are so different. It's almost a surprise to find they speak English.") In maturity there is much to be proved, and strange fears and hostilities get unleashed. But in middle age there is a significant change in the relations between men and women. They draw closer than ever before. They have less to prove. They expect less. They are no longer so frightened or arrogant or shy. Closeness, friendship, love – none of it necessarily destructive of deeper commitments – becomes a wonderfully rich and varied possibility. It is possible to enjoy human beings more than ever.

Apart from this sense of love deepening and widening, there is freedom to undertake an inner journey. The woman has had her children and sees them growing away from her, the man has achieved most of what he can achieve in his job. They have arrived not at an *end, but at a beginning, the start of the adventure for which it was all a preparation. The bodily changes are a reminder that it is time to be starting.*

But what so often makes middle age tragic is the refusal to begin. The man is haunted by disappointment that he did not make a greater splash in "the world", and tormented by erotic fantasy. The woman cannot cease to sigh for a beauty which she thinks she once possessed (and which, often enough, felt strangely alien to her). They linger around old haunts, melancholy and afraid, forfeiting the respect of the young to whom age can only make sense in a context of knowledge and wisdom, since it is necessarily stripped of other attractions.

Why are they so afraid? Because so few now make the journey? Because there must be a real stripping, a sacrifice of what is no longer needed? because for men (at least for men who have achieved separation from the mother) there must be a return to the feminine which feels dangerous? Whatever the reason the broad way of destruction is damnably alluring.

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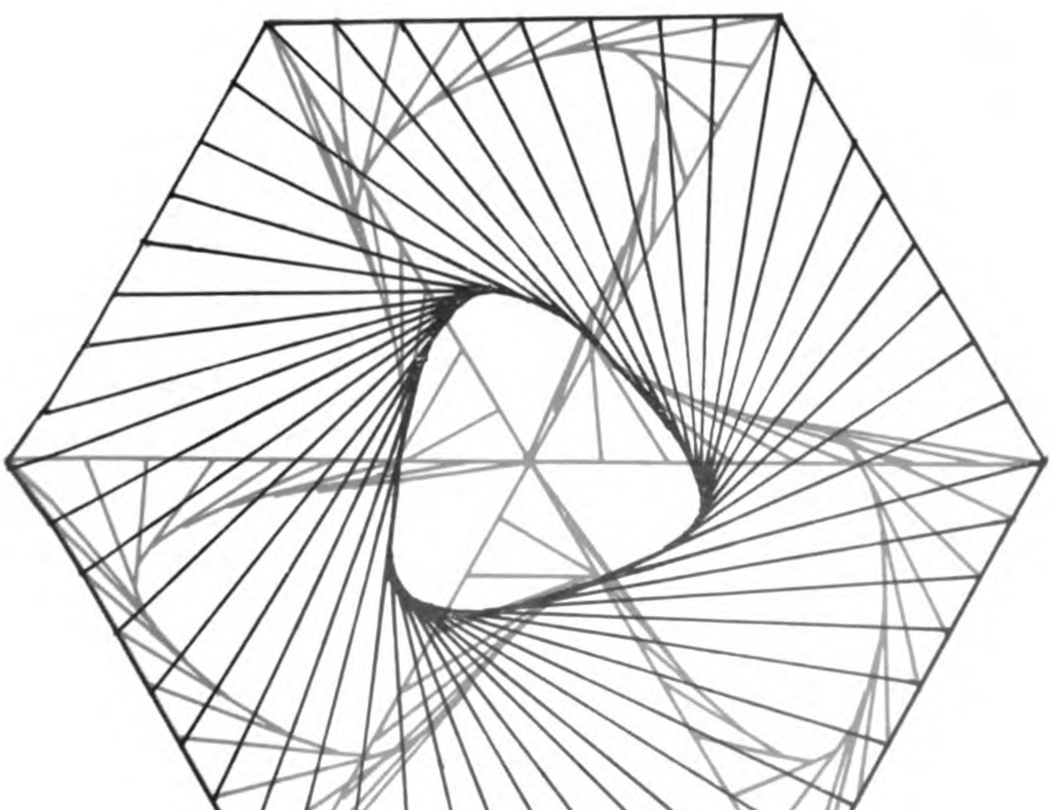

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THEORIA to theory

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Editorial

We are publishing in this number an article written nine years ago by Grey Walter, whose Eddington Lecture, "Observations on Man, his Frame, Duty and Expectations" was reviewed in T. to T. IV, ii. Grey Walter has been a pioneer in the study of Cybernetics, or self-organizing systems, and his "tortoise" *Machina Speculatrix* has gained considerable *reclame*. Not that Grey Walter assimilates living to non-living systems – far from it – but his work has been directed to producing models in which a fairly simple organizing principle endows them with behaviour characteristic in some ways of living systems, and which we might have expected to be very difficult to understand if we hadn't got the models. This article gives a clear exposition in terms understandable to the literary layman – that archetypal figure whom we are always trying to satisfy – of the basic principles of a self-organizing system. This is a notion that has already come up more than once in T. to T., and is likely to go on being one with which readers will find they need to be familiar.

* * *

Another issue which seems clearly ours to take up has been raised by the recent publication of "Le hasard et la nécessité – essai sur la philosophie naturelle de la biologie moderne", by Jacques Monod (Editions du Seuil, Paris 1970). We shall certainly be reviewing this significant work which is apparently already a best seller in France. Also its argument may provide us with insights which will help us bring some generality to the subject of the molecular basis of life of a sort useful to our readers.

* * *

We also have here a translation by Roger Woolger – the first translation in English – of an article by Simone Weil written at the end of her life. Simone Weil (1909-1943) achieved recognition as one of the most significant religious thinkers of our age only with the posthumous publication of her letters, notebooks and essays on religion. In her lifetime she was known as an *engagé* intellectual and political essayist, caught up first in French *Syndicalisme*, then in the Spanish Civil War, and finally in the Free French Movement in London during the war. Her intense preoccupation with the spiritual life was known at this time only to her closest friends but it underlay and inspired much of the political thought and activity of her last years. It is apparent from her *Notebooks* and the essay published here that she was working towards her own mature synthesis of the active and contemplative modes of religious life.

We have not yet circulated readers with information about the proposed Theoria Association, as it has not been easy to see what form this should take, and we do not want to start on the wrong foot. Discussions are under way, and we hope to have more to say about the result of them by the next number.

Discussion: Metaphysics

Victor Ranford, Margaret Masterman, Frederick Parker-Rhodes, Ted Bastin

This discussion was broadcast some years ago in the Third Programme of the B.B.C. We are publishing it now because these approaches to metaphysics are more relevant in the present climate of opinion than they were when it was first given. Of the participants, Victor Ranford has since died; Frederick Parker-Rhodes does research in computational linguistics in the Cambridge Language Research Unit; Ted Bastin is concerned with the theoretical notions, particularly about Time, which may be called for by advances in Quantum Physics. Some of Margaret Masterman's subsequent work on the relations between science and metaphysics is represented by her four articles, Theism as a Scientific Hypothesis *in T to T. i, and also in her contribution "The Nature of a Paradigm" in* Criticism and the Growth of Knowledge *edited by Imre Lakatos (C.U.P. 1970). This volume of papers discusses Thomas Kuhn's view in* The Structure of Scientific Revolutions *that scientific work is guided by "paradigms" which stand, among other things, which she distinguishes, for sets of established beliefs and methods of interpretation through which problems are solved in the science of any given period. Kuhn and Margaret Masterman commenting on him are concerned with crisis situations where paradigms are breaking down. The revolutionary step comes when problems are pictured or modelled in a new way which opens up theoretical possibilities out of which a new paradigm may eventually be established. In this kind of imaginative thinking there is no absolute division between science and metaphysics.*

Victor Ranford

The first question is: What is metaphysics?

Frederick Parker-Rhodes

You know, it's not so easy to get a definition. My acquaintances are scientists rather than philosophers, and I know that for most of them the term "metaphysics" (and even the word "philosophy") stands for the sort of vague speculation they most dislike. I also know, however, that when they are told by philosophers that there may well be a metaphysical component in their own scientific work, they usually don't know at all what to answer, and in their hearts suspect that the accusation may be true.

Margaret Masterman
In philosophy on the other hand, the so-called "metaphysicians" are at present lined up against the so-called "scientific" or "positivist" philosophers. If you're pro-metaphysics, you're anti-logical-analysis and anti-science; if you're pro-science or pro-logical-analysis, you're anti-metaphysics. And this line up prevents any discussion of metaphysics from ever becoming at all profound, since it prevents those few philosophers ever being listened to who have studied both the philosophy of science and metaphysics, and who keep on pointing out the analogy between the two.

Victor Ranford
I think you've got to be careful about assuming that people will agree with you in seeing an analogy between argument in metaphysics and argument in abstract science. It is an analogy, after all, which most scientific workers wouldn't be able to recognize.

Ted Bastin
Nonsense. Why should I be careful, if in my scientific thinking I never notice any real distinction between them?

Victor Ranford
Well, some scientists don't think so. Frederick Parker-Rhodes here is also a scientist. Would you agree with that?

Frederick Parker-Rhodes
Well, I can agree at least to some extent. I feel, you see, that a fresh approach has got to be made to this question of what metaphysics is, and that this new approach has got to be made by people who are concerned with questions of fact, that is by scientists rather than professional philosophers. What we've got to do is to try to get the *feel* of metaphysics, not to define it.

Victor Ranford
But how can you get the feel of metaphysics when there are so many different notions of what metaphysics is? The "feel" might be different according to which one of them you select.

Margaret Masterman
The only way to find out what metaphysics is is by doing it, by applying metaphysical methods, as it were, in a limited field. Queer as it may sound, metaphysics is the traditional way of finding out about fact.

Ted Bastin
Yes, and doing metaphysics is an inescapable activity, not an art which before science began was considered highly important and esoteric, but which everybody has stopped practising since the 17th Century. But in any age the metaphysical method of thinking only seems acceptable when it is done about a subject-matter which is agreed to exist, and which is thought to be fundamental and important. In the time of Aquinas and Spinoza this subject-matter was God. But now in scientific and philosophical circles it would be thought highly disputable to say that God exists at all. It's an agreed fundamental fact, however, say, that language exists; and so it seems quite natural to think metaphysically about language, or – as Newton did in his *Principia* – about matter and force. Western metaphysics hasn't changed its method; what it has changed is its subject-matter.

Victor Ranford
Look here: I'm sure there's more to it than that. *Religious* people who value metaphysics look on it as the clue to all other knowledge. To them it is the most important thing in life. It's no good just saying that metaphysics is a method which can be applied to any subject-matter. Metaphysics is about Being. You've ignored the Western metaphysical tradition.

Frederick Parker-Rhodes
That's a fair criticism, actually, since the history of metaphysics has been appealed to in considering what metaphysics is.

Ted Bastin
I referred on purpose just now to the Western metaphysical tradition, because I think that when you wish to place metaphysics in its traditional background, the first thing you want to do is to distinguish the metaphysics of the East from that of the West.

Frederick Parker-Rhodes
I entirely agree. I'm very interested in the Eastern metaphysical

tradition, more so than in the Western. After all the Eastern metaphysical tradition is far older than that of the West.

Victor Ranford
Well, in theory I agree, but I think that most Western philosophers have felt that it's almost impossible to discover the nature of Eastern metaphysics. The language involved is all too obscure.

Margaret Masterman
I don't agree at all. It's just as easy to give a cursory impression of the metaphysics of the East as of that of the West; in fact easier, because fundamentally there's only one Eastern tradition. I think that the first characteristic of Eastern metaphysics is its claim to authority and universality. It makes no sense, in terms of Hindu or Chinese thinking, to talk about X's metaphysics, or Y's metaphysics, since there is only one metaphysics which is agreed by everyone to be universal and eternal. The kind of unquestioned authority which Eastern thinkers give to metaphysics is much more like the kind of authority which we, in the West, now give to science than the kind of authority which could be gained by anyone's "philosophy". For the East, metaphysics is true; for the West, science is true.

Ted Bastin
Wouldn't you say that the claim to infallible authority made by Eastern metaphysics resembled much more that made, in the West, by the Roman Catholic Church?

Margaret Masterman
In some ways, but not in others. For instance, the claim to infallibility of the Catholic church places a constraint upon Catholics. It is a claim, not a self-evident or agreed fact. But the unquestioned authority of Eastern metaphysics, for those in the tradition, imposes no consciously felt constraint. It does not require of them, for instance, to watch their step, or to condemn other people as unorthodox, or to use any set form of words in their thinking. Any such fixity, for Easterns, resides in the performance of ritual, which is only one of the many special systems generated by Eastern metaphysics. This brings me to my second point, which is that Eastern metaphysics, unlike Western, is not a system-making activity. On the contrary it is the progressive realization that ultimate reality – the

Ultimate ultimate reality – cannot be systematically described, which is at the very heart of Eastern metaphysics. The Eastern idea is that, by the very act of creating a system – *any* system – you destroy your own capacity for apprehending or describing ultimateness, because any system, once you've created it, will have a subject-matter; and once it has a subject-matter – *any* subject-matter – in some respect or other the subject-matter will be limited, and there will be something in fact which you are not talking about. Once this has happened, you will be pursuing a special subject of research, and you will no longer be talking about the totality of ultimate reality.

Frederick Parker-Rhodes
This all seems to me very true.

Margaret Masterman
Profoundly true. The attractiveness and the relevance for contemporary thinking of ancient Eastern metaphysics lies in the fact that it makes of metaphysics, not a set of systematically ordered and highly disputable assertions, but a *principle* – the principle that there can't be any wholly ultimate system. And its second strength is that it creates no field with a specifically religious subject-matter; the most general and therefore the most profound system is not that of theology, but that of mathematics; then that of philology – philology of a very ancient and yet of a very modern kind – and, thirdly, cosmology – which for the ancients was, of course, astrological prophecy. Specifically religious systems, such as liturgical systems, come quite low down on the list, not as being untrue, but as being, in many respects, lacking in generality.

Victor Ranford
Of course this would be highly unacceptable to Christian thinking.

Margaret Masterman
Well I'm not sure. The ancient Eastern view of the nature of a systematic study such as mathematics was not at all like the usual modern "materialistic" Western view; and the principle that there can't be any ultimate system had empirical effects, in that it affected and governed their idea of what the whole activity of system-making was. I think it *is* all rather like the Christian conception of the Via Negativa, according to which God isn't anything that you can ever talk about, since by naming him you are already limiting him, and so it is not God that you are talking about any more.

Frederick Parker-Rhodes
Is it something like this? We are all agreed that metaphysics comprises generalisations of some kind. I would say there were two main kinds of generality. One is exemplified in the classical course of development of scientific theories, which start by covering narrow fields, such as electricity or optics, and later become fused into wider theories of which the earlier ones can be regarded as special cases or approximations. The classical case of this is Clerk Maxwell's electro-magnetic theory, which was general enough to cover light as well as electricity and magnetism. The other kind of generality consists in continuing to use familiar words and established logical rules, but widening and loosening the meaning of the terms so that the field of application of what is said is enlarged. This is the standard practice in mathematics. We start with the simple notion of whole numbers, one, two, three, etc., which apply to groups of objects, and step by step widen the meaning of number so that we can have fractions and negative numbers, and still later bring in the idea of irrationals and what mathematicians call real numbers, which have no *direct* application when we are only counting or measuring things. Yet as we proceed in this way our concepts get more useful, not less, because each stage presupposes the stage before, but covers a much wider field. Is the kind of metaphysics which has been labelled "Eastern" anything like this second kind of generality? On this Eastern way of thinking you aim at reaching the last stage in the process of emptying the terms used in the specialized disciplines of their original meanings. The ultimate generality is inexpressible, yet it is claimed that this does not mean it is useless. Eastern metaphysics is a principle.

Victor Ranford
But if you have something quite general and inexpressible, however can you call it a "principle"? And how can it have a use? Hasn't a principle got to be definite to some extent? But perhaps I don't understand what you are meaning by a principle.

Margaret Masterman
Can I say what I should mean by this kind of principle? If we were talking in Indian terms I might quote the Hindu formula "Absolute Being exists". One's reaction to this is meant to be that as soon as one has stated it one realizes that the very act of applying the notion of absoluteness to the notion of Being limits Being, and applying

"existence" to the compound notion of Absolute Being limits the whole string of notions yet further. Thus each application of a notion is seen by the Hindus to be a limiting restriction. The total reality being completely unrestricted cannot be accurately described in language, as I said, for the very act of naming it puts a restriction on it. Thus the slogan "Absolute Being exists" is used in order to be discarded, it is like Wittgenstein's descriptions of the propositions in his *Tractatus*, a ladder which one throws away as soon as one has used it. The Zen Buddhists, in the Chinese form of the tradition, try to convey this same feeling for unlimitedness by talking exclusively in paradox and nonsense. "What was the prime motive of our Founder? Answer: Have a cup of tea. Reply: I see you have the perfect knowledge."

Victor Ranford
But how does this show the use of any principle?

Margaret Masterman
I'll quote what I think is the Chinese form of the principle, since the Chinese tradition seems to me more intelligible than the Hindu. It is MoTsu's first principle of reasoning in his *Minor Illustrations* "That which is limited is not universal". I propose to produce an analogue of this: "The more fundamental a concept, the more unlimited its meaning". This already looks a good deal more like what we want a principle to be.

Suppose now this was pushed to a limit. Mathematicians would never so push it because completely derestricted concepts wouldn't be of any use in mathematics. But let us imagine a process like the mathematically derestricting process you were describing just now being pushed to its limit. This was what these Eastern metaphysicians did imagine, and it was this effort of imagination which made them say absolutely complete generality would be inexpressible.

Victor Ranford
Are you suggesting that the contemporary inability to understand what metaphysics is is bound up with the inability to understand mathematical insight?

Margaret Masterman
Yes. The first step in understanding metaphysics lies not in understanding religion but in understanding mathematics.

Victor Ranford
Many mathematicians wouldn't agree.

Margaret Masterman
It remains a fact, however, that it has been the mathematically minded philosophers, not the literary ones, who have been the great metaphysicians.

Ted Bastin
Let's get back to this principle of yours. It seems to me to be related to the fact that the creative moment in mathematical thought is liable to be reached by a moment of insight, of sudden illumination, of "realization". This the Easterns clearly think can be generalized one step further; total unlimitedness might be realized by a hyper-mathematical intuition. Then, having reached it, the metaphysician can go back to the specific, realizing that it is a limitation upon unlimitedness, and proceed again to his special studies with a deeper insight into the direction of his progress.

Victor Ranford
I don't see: and I don't believe anyone will.

Margaret Masterman
Well, what would it be like to have the opposite principle? The opposite principle would be: "The more fundamental a principle, the narrower, more restricted and exact its meaning".

Ted Bastin
This is the principle of a kind of atomism some people hold. And the result of holding it would be that mathematics, and with it all mathematical science, would have developed in the opposite direction – towards particularity. Mathematics would end up by being like Wittgenstein's primitive arithmetic where you have "One, two, three, many, many . . .", and this applies only to sheep.

Margaret Masterman
And along with this would go a wrong conception of language in which language would be falsely thought to consist of exact concepts instead of imposing progressive restrictions on a fundamental unlimitedness which can always be derestricted again.

Victor Ranford

But isn't there a simpler route to a similar conclusion? I don't want to quarrel with the argument that science does point to metaphysical principles. But there are hundreds of people who have thought metaphysically who have not been acquainted with any kind of developed science. Cannot metaphysical principles come out of an examination of ordinary experience, as well as out of problems arising in advanced science?

Frederick Parker-Rhodes

Yes, if you will first say what you mean by "experience".

Victor Ranford

I should want to start from experience as we all have it. I don't want to speak vaguely of Experience with a big E; yet I do not believe that individual experiences can be completely isolated from one another. Let us suppose, however, that we do have relatively isolated experiences; for example, I see a window. Any such bit of experience is not to be thought of simply as something happening outside the person who has it. Dividing the experience into what is subjective and what is objective is part of the analysis we make in the process of getting to know it. Another part of this analysis is to isolate the window from the total visual field. And another part is the isolation of a "specious present" from the instants which come before and will come after it.

Ted Bastin

I see how this shows that the metaphysical principle already arises when we attempt to make an analysis of our ordinary experience. But you've got to show that the metaphysical principle makes a difference to the way we interpret our ordinary experience which would be at all analogous to the way general fundamental principles affect science.

Victor Ranford

Well, let's come back to reflecting on the apparently trivial facts – that ordinary experiences are not completely isolable from one another, that perceiver and percept aren't completely distinguishable, that one instant of perception can't be completely separated from the instants that come before and after. We find that we have to consider the possibility that, in order to account for all this, we have to turn upside-down our whole description of how apparently isolated objects are really perceived. There is nothing original, so far, in what I've had to say. Other philosophers – those, that is, who have usually been considered as being in the idealist tradition – have said this before. But I want to propose a change in our account of how we come to form isolates in experience, which is more fundamental than that given by the idealists. What I want to propose is much more like that given in different ways by Bergson and by Whitehead. I suggest that we start by taking as given a total undifferentiated unlimitedness, a sort of multisensory blur, in which the perceiver would be also included. We can compare this blur to a piece of countryside seen by a painter intending to paint it when he deliberately screws his eyes up so that he sees neither its boundaries nor any differentiation within it. Then, remembering his earlier view, he begins to paint in his mind, by putting successively a set of limitations upon what he conceives of, but no longer sees, as being the original landscape. This gives him the design, but it's important to notice that he does not get the design all at once. It's not true that a fully formed pattern suddenly imposes itself upon the blur. What happens is that he introduces an ordered set of limitations upon a continuum, upon its total unlimitedness, upon its blur. He may, for example, paint the whole background in first; the whole universe of his canvas is thus limited by being made blue or grey. Then he may superimpose a shape in flat colour on this background. Then a second shape related to this by position, and thus affecting our view of it. And so on. But a time will come when, having seen the design as a whole, he feels the need to put in some object in detail, and so he puts in a tree green, or a tree and a stream and a boy in a red coat beside it. This object or group can be called an *isolate*. It is the focusing point of the whole picture, the rest of which is given in much less detail.

I want to put forward the view that when I perceive an object, for example, a window, a table, a chair, a noise, I go through a process not less complex than that which the painter goes through in painting his picture, and this is why the object which is the end-product of perception is never completely isolated either from the general design of which it is a part or from the total blur. There was an antecedent unlimitedness from which it has been abstracted (or, as Whitehead called it, "concreted") by ordered stages of limitation.

Frederick Parker-Rhodes

Why be so complicated? I don't find I see things initially in an unlimited blur, and then proceed to construct isolates. I see things quite clearly outlined from the beginning.

Victor Ranford

You do, because for years you've become accustomed to seeing them like that. But the painter I described, who deliberately screws up his eyes so that he doesn't see the accustomed boundaries, and then begins to find a fresh pattern taking shape in the blur, may be doing something like the metaphysician who takes away the ordinary common-sense boundaries which we accept in the meanings of our words. This, of course, is just what the philosophers of "ordinary language" accuse him of doing. I suggest that there is a point in his doing it. He stretches the meaning of words more and more until he comes to a meaning which seems so general as to be totally unlimited so that he is on the edge of what is inexpressible. But then he must proceed to impose new limitations, just as the painter does, who gradually builds up a new definite bounded pattern after he has broken down the patterns of his everyday vision.

Frederick Parker-Rhodes

This may be true of the painter. But does all this apply at all to what the scientist does?

Victor Ranford

I think we get an example of it in what Freud did – a good example because he used ordinary language. In his use of certain common words, notably "sex", he had to extend their customary meanings. He made the word "sex" mean something so general that it was on the point of becoming quite indeterminate. He didn't just add a concept to an existing language, but created a new area of indeterminacy where people had before thought they knew what was meant. This indeterminate area had to be limited again, and the way he limited the concept of sex has made it more scientifically useful than it was before.

Ted Bastin

If I've been able to understand you, what you've been saying seems to me quite plausible. I believe that a process like this does occur in scientific thinking.

Victor Ranford

If you agree to that, the realization of unlimitedness would seem to have a place, not only in ordinary perception, but also in the process of scientific discovery.

Frederick Parker-Rhodes
Ah, if I get your meaning, I can suggest perhaps another example; this comes from the history of botany. I'm thinking of the morphological views associated with Goethe. Although he did not have before him the metaphysics we are talking about, nor of course any idea of the modern notion of homology, Goethe hit upon the idea that the semantic content of the term "leaf", already wide enough to embrace such different objects as a pine needle and a rhubarb leaf, could be widened still further so as to include, as special cases, such structures as are separately called bracts, sepals, stamens, carpels, etc. And he then conceived of particular objects of this kind as expressions of this widened leaf idea, limited not only by what species of plant bore them but also by whereabouts on the plant they grew. However, it was really no more than a guess, and in no sense a scientific hypothesis. This was because Goethe failed to suggest what material process there might be underlying the various limitations of his metaphysical primordial leaf (*Urblatt*, as he called it) had to undergo before it became a particular buttercup. That is to say, he did not tell us how we might *prove* his assertions about leaves, nor how they might fit in with the whole body of scientific knowledge. Nowadays we can fill these gaps: our knowledge of phylogeny and ontogeny is sufficient to enable us to see how in fact a limiting process such as Goethe imagined could operate, and to test whether it does by the methods of experimental morphology.

Margaret Masterman
Has this theory of Goethe's stood up to these later tests?

Frederick Parker-Rhodes
Well, it is found that the Goethean homologies are usually, but not always, valid. Several points of detail are now much is dispute, such as, for example, whether carpels are covered by the theory. On the other hand, the theory of evolution correlates the particular question of leaf origins with a very wide range of related phenomena; though it incidentally shows us that the supposed single primordial *Urblatt* is in reality at least two *Urblätter*, one of which originates as a special outgrowth from the primitive stem and accounts for the leaves of club-mosses and, perhaps, conifers, while the other starts as a whole branch of a primitive plant, and leads to the leaves of the majority

of modern plants. These two kinds of leaf started quite independently, and if we are to attach any significance at all to the generalisation of the leaf-concept which includes both, it is in terms of function and not in terms of origin. From this illustration you can see that our metaphysical principle can be used to assist the birth of a theory but is not sufficient in itself to produce one. The process of theory-making is a particular, limited case of the principle itself, limited by the scientist's need to correlate his terms at every stage. But he is guided by the search for that kind of greater generality which points, in the end, towards complete unlimitedness. What Goethe didn't realize is that, in this progression, he was only taking the first step.

Victor Ranford

Now you are getting back to the Eastern view of metaphysics, as an activity where you go on giving words more and more unlimited meaning until you come to a point where some would say the words are just vacuous, and others would say that you reach an intuition of the inexpressible which sets you free from being bound by the limited meanings imposed by custom and ordinary life. I still don't see that this is the same as the Western view which makes metaphysics consist of certain very general principles which can perfectly well be stated, and the more specific effects of which can then be systematically worked out.

Margaret Masterman

This Eastern view links up with one form of Western metaphysics. The views of Bergson and of Whitehead have been referred to. Whitehead thought that all enunciations of general principles were approximations to a complete generality which we can never reach, but that metaphysics consists in the attempt to reach it. But he also assumed the Western notion of metaphysics as system-building, and tried to make a system out of the provisional principles he had reached by stretching and generalizing concepts derived from several separate sources, mathematics, biology, human history – which didn't really cohere with one another.

Ted Bastin

Isn't the point that one can't have metaphysical *systems* as it were on top of the scientific ones? Whereas you can have metaphysical *principles* which can help you create scientific theories.

Victor Ranford
This, of course, would be a likely consequence, if, as I said, our fundamental experience is of an unlimited continuum, not of a collection of distinct and isolated objects.

Ted Bastin
Look here, I'm a physicist, and I'm in general very much in agreement with this view of the way a metaphysical principle can work. But I'm bound to differ from you to some extent about this. You are talking as though this complete unlimitedness were the *one* metaphysical principle, and from this you are led to the conclusion that certain ways of thinking about the world, namely those leading in general to atomistic conceptions, are out. Now to my mind this is correct as applied to the intellectual situation in which we are at present, since the prevalence of theories which stress the discrete structure of matter and the atomic nature of language is, in my view, cramping our fundamental thinking. But I can imagine us in a different intellectual situation in which, as metaphysical thinkers, we found ourselves needing to invoke a quite different metaphysical principle.

Frederick Parker-Rhodes
Could you illustrate that?

Ted Bastin
It's like this. The non-metaphysical person simplifies and tends to pick out one principle – atomism, for instance, or empiricism – and freezes it and gives it rigid application. The metaphysically minded person, on the other hand, is driven to a deeper sense of ultimate complexity, so that he is aware that, whatever is said with the help of the principle, like atomicity or empiricism, there is also something else that can be said with the help of another. He will want to stress the points at which the dominant principle is only one intellectual principle which may break down.

Margaret Masterman
Give an example.

Ted Bastin
Fundamental particles. The majority of physicists take what we might call a simple realist attitude to fundamental particles. But there are important respects in which the particles in question are

very unlike ordinary material objects, and I think you will tend to find the metaphysically minded person always wishing to stress these latter aspects, and therefore insisting on retaining a grasp of the complexity of the experimental situation. In effect the metaphysically minded person tends to find himself opposing whatever happens to be the current orthodoxy. I think, in any age, the main current of thought is usually a hardening into a dull common sense of the application of one particular metaphysical concept. In the case I have mentioned the metaphysical concept which has become dogmatic is that of the physical reality of the particles. This particular situation is interesting because another set of thinkers over-simplifies in an opposite way by completely denying the physical reality of these particles. It is left to the metaphysically minded person to preserve the complexity and not try to over-simplify in order to make this fundamental problem intellectually comfortable. So metaphysics, far from foreclosing possibilities, has a liberating effect. It expresses our intention to preserve complete freedom to establish new connections of any kind whatsoever.

Victor Ranford
We started by saying that the word "metaphysics" is usually a red rag to scientists because they mean when they say that a person is "metaphysical" that he is allowing himself to be governed by preconceived ideas rather than by experimental facts. But if you are right the boot is on the other foot. It is the non-metaphysical person who is tied by preconceptions.

Frederick Parker-Rhodes
Well, where have we got? We have been taking a principle of Eastern thought, and considering alternate processes of derestricting meanings until we reach a generality which seems to be on the edge of the inexpressible, and then of restricting the meanings again. We have said that this is a method of thinking which brings us to a boundary point where new fundamental concepts may be created, and new ways of ordering experienced. And that if these can be connected with precise techniques they may generate new sciences and scientific theories. Here we have three scientists in quite different disciplines – physics, biology and theory of language – all saying that they find a principle like this fruitful in their scientific thinking.

Ted Bastin
I believe that this has to do with religion too, and I'll say why.

We've said a good deal about the way a metaphysical principle can be involved in the creation of a new scientific idea. Now I think it is a common experience among scientists that such a process of discovery is associated with a complete breakdown of previous thought-connections before the new connections can emerge. I believe that in this state of intellectual desolation the metaphysical principles stand out as the only guide one has left. This is an ascetic and contemplative experience.

Margaret Masterman
Yes, and isn't it in fact the case that nowadays it is the creative scientists, who are willing to be stretched in this way, who are having mystical experiences, rather than the people who only live in terms of a fixed ritual system?

Victor Ranford
Are you attacking orthodoxy?

Margaret Masterman
Not a bit.

Victor Ranford
Yes, but it's not only lazy religious people who are creatures of habit. Many scientists are, as you've just been saying. And you need not only be a creative scientist to live on the frontiers of experience. Many religious people do this: those from whom come the saints. The principle of unlimitedness that we've discussed operates in ordinary experience, as well as in scientific life. But what, in fact, are we claiming for this principle? We aren't claiming that it gives us a licence to produce metaphysical *systems*. Nor are we claiming that there isn't a great deal more that needs to be explored about metaphysical principles and how they work. We have said that the principle shows that there is not one fixed frontier, permanently in one place, between what can be talked about and what can't, that the boundary shifts as new ways of thinking are developed. If this principle that we've been discussing keeps us on the boundaries, then it has a liberating effect upon our efforts fundamentally, and religiously, to understand the nature of the world.

Frederick Parker-Rhodes
And if that isn't metaphysics, I don't know what is.

Are we struggling for Justice?

Simone Weil

This essay, entitled "Luttons-nous pour la justice?", was written in London in 1943 when Simone Weil was working for the Free French Movement. It was published posthumously in Preuves *(June 1953) and later in* Ecrits de Londres *(Gallimard, Paris, 1957). Written at the time when she was completing her great political treatise* The Need for Roots (L'Enracinement), *this essay deals more explicitly with relating political reality to supernatural reality and contains one of the most succinct accounts of Christian love that she left us. This translation, the first in English, is published now with acknowledgements to Editions Gallimard and M. André Weil.*

"The investigation of what is just is only achieved when there is equal necessity on both sides. Where there is a strong and a weak party what is possible is carried out by the former and is accepted by the latter."*

So, in Thucydides, spoke the Athenians who had brought an ultimatum to the wretched little city of Melos.

They added: "It is a necessity of nature that each one always commands wherever he has power to do so; this we believe to be true of the gods and know to be true of men."

In two sentences they thus expressed the whole of political realism. Only the Greeks of this period knew how to conceive evil with such marvellous lucidity. They themselves no longer loved the good, but their fathers, who had loved it, had passed on its light to them. They used it to know the truth of evil. Men had not yet to live a lie. That is why it was not the Athenians but the Romans who founded an empire.

These two sayings are the kind that shock good people. Yet so long as a man has not experienced the truth of them in his flesh

* *Translator's note:* All Simone Weil's translations from classical and New Testament Greek are her own. Rather than give standard translations into English I have throughout rendered her own French translations into English in order to retain, as far as possible, her style and emphasis.

(I wish to express my indebtedness to M. André Weil for carefully reading this translation and making many helpful suggestions. R. W.)

and blood and in his whole soul he cannot have access to the real love of justice.

The Greeks defined justice admirably as mutual consent.

"Love," said Plato, "neither causes nor suffers injustice, neither among the gods nor among men. For whenever Love suffers a thing he does not suffer it by force; for force cannot reach Love. And when he acts, he does not act by force; for everyone consents to obey Love in all things. Wherever there is agreement founded upon mutual consent there is justice, according to the laws of the royal city."

From this, the opposition between the just and the possible in the words cited by Thucydides is very clear. When there is equal strength on both sides the conditions for mutual agreement are sought. But when someone does not have the power to refuse, no one troubles to look for a way of obtaining his consent. Then, only those conditions which correspond to objective necessities are examined; nothing but the acquiescence of matter is sought.

In other words, human action has no other regulation or limitation than obstacles. It does not come into contact with any other realities than these. Matter imposes obstacles which are determined by its own mechanism. A man is capable of imposing obstacles by means of the power to refuse which sometimes he possesses and sometimes does not. When he does not possess this power he does not constitute an obstacle, nor, consequently, a limitation. Relative to the action and to him who performs it, he has no existence.

Every time there is action, thought proceeds towards its goal. In the absence of any obstacles the aim would be realised as soon as thought of. At times it is like this. A child sees his mother from afar after an absence and he is in her arms almost before realizing that he has seen her. But when immediate realization is impossible, the thought which is, to begin with, fixed upon its objective becomes engaged by obstacles.

It is only these obstacles that engage thought. Where they do not exist it is not arrested. Whatever does not constitute an obstacle to the material realization of its action – men deprived of their power to refuse, for example – is as transparent to it as perfectly clear glass.

Whoever does not see a sheet of glass is not aware that he does not see it. Whoever is situated elsewhere and does see it, is not aware that the other person does not see it.

When our desire's will is translated outside ourselves through actions which are carried out by others, we do not waste our time or powers of attention in seeing whether they have consented to them. This is true of all of us. Our attention, which has been entirely spent on the success of the undertaking, is not engaged by them so long as they are docile.

So much is necessary. If it were otherwise things would not get done and if things did not get done we should perish.

But because of this fact action is tainted with sacrilege. For human consent is something sacred. It is what man grants to God. It is this that God comes in search of among men in the guise of a beggar.

The very thing that God is continually begging each man to grant is exactly what men despise.

Rape is a frightful caricature of love from which consent is absent. Next to rape, oppression is the second horror of human existence. It is a frightful caricature of obedience. Consent is as essential to obedience as it is to love.

The butchers of the city of Melos were pagans in the despicable sense of that word, in a way quite different from their fathers. In a single phrase they defined, completely and perfectly, the pagan outlook.

"We believe regarding the gods that each one, by a necessity of nature, always commands wherever he has power to do so."

The Christian faith is but the cry of the contrary affirmation. The same is true of the ancient teachings of China, India, Egypt and of Greece.

The act of Creation is not an act of power. It is an abdication. By this act a realm has been established other than the kingdom of God. The reality of the world is made up of the mechanism of matter and the autonomy of rational creatures. It is a realm from which God has withdrawn Himself. Having renounced being its king, God can only come here as a beggar.

As for the cause of this abdication, Plato expresses it thus: "He was good."

Christian doctrine contains the notion of a second abdication: ". . . Being of divine condition, he did not regard equality with God as a booty. He emptied himself. He adopted the condition of a slave. . . . He lowered himself to the point of being made obedient even to death. . . . Even though he was the Son, what he suffered taught him obedience."

These words could be a reply to the Athenian murderers of Melos. They would have made them laugh heartily. They would have been right. Such words are absurd. They are madness.

Indeed, just as the content of these words is absurd and foolish, so would it be proportionately absurd and foolish to obtain consent where there exists no power to refuse. It is the same folly.

Yet Aeschylus said of Prometheus: "It is good to love to the extent of appearing foolish."

The folly of love, when it has seized hold of a human being, completely transforms his modalities of thought and action. It is allied to the folly of God. The folly of God consists in requiring of men their free consent. Men possessed by the folly of love for their fellows are disturbed by the thought that there are human beings the world over who serve as intermediaries for the desires of others, without ever giving their conscious consent. It is unbearable for them to realize that this is often the case where their own desires and the desires of the groups they belong to are concerned. In all their actions and thoughts in relation to human beings, whatever the nature of the relationship, each man who confronts them, without exception, is constituted of the faculty of free consent to the good by means of love, a faculty which lies imprisoned within both the soul and the flesh. Neither doctrines, conceptions, inclinations, intentions, nor wishes can lead to this transformation. It is folly that is needful.

A penniless man who is gnawed by hunger cannot perceive anything connected with food without suffering. For him, a town, a village, a street contains nothing but restaurants and food shops surrounded by other vague houses. Walking along a street, it is impossible for him to pass in front of a restaurant without stopping. Apparently there is no obstacle in his way. Yet there is one for him because of his hunger. The other passers-by, who stroll along absent-mindedly or go about their business, move through the streets as if in front of a theatre set. But for him each restaurant, by virtue of the obstacle caused by this invisible mechanism, possesses the whole of reality.

The condition for this is that he is hungry. Nothing occurs if he does not have within him a need which gnaws his very body.

Men struck by the folly of love need to see the faculty of free consent spread throughout the world, in all forms of human life, amongst all human beings.

What does it matter to them? think reasonable men. It is not their fault, the poor wretches. They are mad. Their stomachs are out of order. They hunger and thirst after justice.

Just as all restaurants to starving men so do all human beings appear real to these men. To them alone. It is always a particular trick of circumstances or a special gift of personality which arouses in ordinary men the feeling that such and such a human being really exists. It is only these fools who can direct their attention to no matter what human being in no matter what circumstances and receive from him the shock of reality.

But for this they must be fools, for they have to carry within them a need which is as destructive to the equilibrium of the soul as hunger is to the functioning of the organs.

The vast mass of those beings deprived, as they are, of the power to grant or refuse consent do not, as a whole, have the least chance of raising themselves high enough to possess such power without some complicity on the part of those who command. But such complicity exists only among the fools. And the more folly there is down below the greater the chances that folly may appear, by contagion, at the top.

One has to be blind to oppose justice to charity; to believe that their realm is different, that one is wider, that there is a form of charity beyond justice or a form of justice this side of charity.

Whenever the two notions are opposed, charity becomes no more than a caprice, frequently of base origin, and justice nothing other than social constraint. Whoever is unaware of this has either never found himself in situations where there is total licence for injustice, or else has become so implicated in the lie as to believe that justice can easily be practised in such situations.

It is just not to steal from shop counters. It is charitable to give alms. Yet a shopkeeper can send me to prison. A beggar, even though his life depended on my help, would not report me to the police if I refused to give him anything.

A great many of the controversies of the Right and the Left can be reduced to this opposition between a preference for individual caprice and a preference for social constraint; or to put it more precisely, perhaps, between the horror of social constraint and the horror of individual caprice. Neither charity nor justice have anything to do with it.

The object of justice is the earthly exercise of the faculty of consent. To preserve it religiously wherever it exists, to try to create conditions for it to arise where it is lacking, this is to love justice.

In the one single and glorious word "justice" is contained the whole meaning of the three words of the French emblem. Liberty is the real possibility of consent being granted. Men do not require equality except with reference to it. The spirit of brotherhood consists in wishing it to all.

The possibility for consent is provided by a life which contains motives for consent. Destitution and privation of the body and soul prevent such consent from operating in the secret recesses of the heart.

The need for an expression of this consent is a subordinate one. An unexpressed thought is imperfect, but if it is authentic it can carve for itself indirect ways towards expression. An expression to which no thought corresponds is a lie, and there is always, everywhere, the possibility of lying.

Since obedience is in fact the unshakeable law of human life the difference is between obedience that is consented to and obedience which is not. Wherever obedience is consented to there is freedom; there, and nowhere else.

It is neither in Parliament nor in the press nor in any institution that freedom can reside. It resides in obedience. Wherever obedience lacks the everyday, permanent savour of freedom there is no freedom. Freedom is the savour of true obedience.

The forms and expressions of consent vary a great deal in different traditions and environments. Thus a society composed of men freer than us can, if it is very different from ours, appears despotic to us in our ignorance. We fail to realize that outside the realm of words there are differences of language and meaning and the possibility of mistranslations. And we preserve our ignorance of this, since it flatters in us a shameful but unacknowledged love of conquests which enslave under the banner of liberation.

On the other hand there is a certain type of devotion tied up with slavery which, far from being a kind of consent, is the direct effect of a brutal system of constraint; for in affliction human nature searches desperately for compensations in no matter what quarter. Hatred, flat indifference, blind attachment, all serve one equally well in escaping the thought of affliction.

Wherever there is freedom there is the blossoming of happiness, beauty and poetry; such is perhaps the only certain sign of it.

Democratic thought contains a serious error; this lies in confusing consent with a certain *form* of consent which is not the only one and which, like all forms, may become hollow.

Our parliamentary democracy was vain, because in choosing some of our leaders we despised them, whilst we bore a grudge against those we had not chosen and we obeyed them all with reluctance.

Consent is not for sale, nor is it to be bought. Consequently, no matter what political institutions there may be, in a society dominated by monetary transactions and where practically all obedience can be bought or sold, there can be no freedom.

Just as oppression is analogous to rape, so too the domination of money over labour, pushed to the extent where money becomes the motive for work, is analogous to prostitution.

Enthusiasm is not consent, it is a superficial allurement of the soul. It is to consent what conjugal union is to a debauched man's corrupt liaison with a depraved woman.

Where no other motives are recognized but constraint, money, and a carefully stimulated and bolstered enthusiasm, there is no possibility of freedom.

Indeed, in varying degrees, such is almost the case today in all countries inhabited by the white races and in all countries where the influence of the white races has penetrated.

If England is, to a fairly large extent, an exception, this is because she still retains some of her past alive and intact. This past, everywhere present in her, has been, for a moment, the only saving light for the world. But there is no comparable treasure elsewhere.

Unfortunately freedom is not something quite close that we may rediscover; it is not a familiar object of which we have been robbed by stealth. It is something that has to be created anew.

We French have formerly launched into the world the principles of 1789. Yet we are wrong to take pride in this. For neither then nor since have we known how to think about them or to put them into practice. The memory of them should rather teach us humility.

It is true that humility seems sacrilege when one's country is concerned. But such a prohibition sets up a barrier between modern patriotism and the spirit of justice and love. The Pharisaic spirit poisons at its source every feeling from which humility is excluded.

Modern patriotism is a sentiment inherited from pagan Rome and has come down to us over the Christian centuries without being baptized. For this very reason it is out of key with the spirit of the principles of 1789; in truth they cannot be reconciled with each other as would be indispensable for the French.

Such as it is, it can steel men to go as far as the supreme sacrifice, but it is unable to nourish the desperate masses of our time. They need something which is not cornelian* but is accessible, human, warm, simple and without pride.

In order that obedience may receive consent, above all we stand in need of something to love, something for the love of which men will consent to obey.

Something to love, not as a result of hating its opposite but in itself. The spirit of consenting obedience proceeds from love, not from hatred.

Hatred provides, it is true, an imitation which is at times very brilliant, but yet one that is mediocre, of poor metal and one which hardly lasts, wasting itself swiftly.

We need something to love not for its glory, its prestige, its brilliance, its conquests, its radiance, its future expansion, but in itself, in its nakedness and its reality – just as a mother whose son is first in the competition for the Ecole Polytechnique loves something altogether different in him. Without such a thing, the sentiment is not deep enough to be a permanent source of obedience.

What is needed is something a people can love naturally, from the bottom of their hearts, from the depths of their own past and from the aspirations of their own tradition; and not as a result of suggestion, propaganda or foreign importation.

What is needed is a love imbibed naturally with our milk and which brings adolescents to conclude once and for all, in the innermost secrecy of their hearts, a pact of fidelity for which an entire life of obedience is but its continuation.

What is needed are forms of social life arranged in such a way as to continually remind the people, in the symbolic language most intelligible to them and most in harmony with their customs, traditions and attachments, of the sacred nature of this fidelity, of the free consent from which it issues and of the rigorous obligations proceeding from it.

In France, from this point of view, the Republic, universal suffrage, an independent trade union movement, are quite indispensable. Yet these things are infinitely far from being sufficient, since they had become indifferent and only began to attract interest a long time after they had been destroyed.

As for the Empire, if the preceding suggestions contain any truth, we are under a strict obligation, short of total falsehood, to recon-

* (A reference to the French tragedian, Corneille, whose heroes all display superhuman stoic courage in the face of adversity. *Translator's note.*)

sider all problems concerned with the colonies in a totally different light from hitherto.

We shall not find liberty, equality and brotherhood without renewing the forms of our life, without the creation of a social fabric, and without a flow of new discoveries.

But it seems that we are too exhausted for such a flow of discoveries.

Men as a whole have reached, morally speaking, such a degree of sickness that there seems to be no cure for them except a miraculous one. A miraculous one, that is, but not an impossible one; but one which is possible only in certain conditions.

The conditions in which a soul can become open to grace are of order different from those of the operation of a mechanism. But they are fixed even more rigorously. It is even more impossible to find any ruse or trick to be able to escape them.

It is not easy to fight for justice. It is not enough to weigh up which side has the least injustice and, having joined it, to take up arms and expose oneself to enemy arms. Without any doubt this is glorious, more than words can say. But men on the other side do exactly the same.

One has to be possessed by the spirit of justice. The spirit of justice is nothing other than the supreme and perfect flower of the folly of love.

The folly of love makes compassion a far more powerful motive for every kind of action, including fighting, than greatness, glory or even honour.

It leads one to abandon everything for compassion and, as St. Paul said of Christ, to empty oneself.

Even in the midst of unjustly inflicted suffering it makes one consent to suffer the universal law which exposes every creature in this world to injustice. This consent protects the soul from evil; in the soul where it dwells it has the miraculous virtue of transforming evil into good, injustice into justice; by it, suffering welcomed with respect and without baseness or revulsion becomes something divine.

The folly of love disposes one towards discerning and cherishing equally, in all human groups without exception, in all places on the globe, their fragile potentialities for beauty, happiness and fulfilment upon earth; it disposes us to wish to preserve them all with an equally religious love; and where they are lacking, to wish tenderly to rekindle the smallest traces of those potentialities which once existed, the tiniest germs of those yet to be born.

Into a part of the heart deeper than indignation and courage, into the place whence indignation and courage draw their very strength, the folly of love instils tender compassion for an enemy.

The folly of love does not seek to express itself. But it is irresistibly radiated by accent, tone and manner through all thoughts, words and deeds and in all circumstances without exception. It renders all thoughts and deeds through which it cannot radiate impossible.

It is truly folly. It hurls one into the midst of risks that one could never run if one had pledged one's allegiance to anything at all in this world, were it a great cause, or a Church or a country.

The end to which the folly of love led Christ is not, after all, a recommendation for it.

But we must not fear its perils. It does not dwell in us. If it did dwell there it would make itself felt. We are rational beings, as is obviously befitting for those who are concerned with the great affairs of the world.

But if the order of the universe is a wise order, there must at times arise moments when, from the perspective of earthly reason, the folly of love alone is rational. These moments can only be those when, as today, mankind has become mad from want of love.

Is it so certain today that the folly of love is not capable of supplying the masses in their misery, whose bodies and souls are starved, with a nourishment far easier for them to digest than inspirations from a less lofty source?

And then, is it certain that we, such as we are, are at our place on the side of justice?

(translated by Roger Woolger)

The Development and Significance of Cybernetics*

W. Grey Walter

In American academic circles the Greek letters Phi Beta Kappa have a particular meaning; they are the initials of a society of distinguished scholars, selected for their talent and attainment in the Arts or Sciences.

These letters stand for the maxim:

"Philosophia Biou Kubernetes"

which is generally supposed to mean:

"Philosophy is the steersman of Life".

During the last ten years the essentially ambiguous statement (and ambiguity is a common feature of classical maxims) might well be considered to have been resolved by inversion; for cybernetics, the art and science of control, has been claimed to provide a new and powerful philosophy in which the problems of physical, living and artificial systems may be seen as an intelligible whole. To what extent is this claim justified and from what has this school of thought developed?

Historically, the term cybernetics was first used in a general sense by Ampère in his classification of human knowledge as "la cybernétique: the science of government". In etymology the term is, of course, cognate with government, *gubernator* being the Latinized form of the Greek for "steersman". The re-introduction of the word into English by Norbert Wiener as the title of his book, published first in France and later in America, marked the beginning of the new epoch in which the problems of control and communication were explicitly defined as being common to animals, machines and societies, whether natural or artificial, living or inanimate. The origin of Wiener's interest in this development was the invention of electronic aids to computation toward the end of the war, combined with his personal contact with neurophysiologists who were investigating the mechanisms of nervous conduction and the control of muscular action. Wiener was at once impressed by the similarities

* **Published in *Civiltá delle Machine*, Italy, 1962.**

of the problems posed by military devices for automatic missile control and those encountered in the reflex activity of the body. As a mathematician and scientist of international repute and wide culture Wiener was as powerfully repelled by the military applications of his skill as he was attracted by its beneficent uses in human biology. In his second book "The Human Use of Human Beings" he develops his humanist, liberal ideas in application to social as well as physiological problems, in the hope that it may not be too late for the human species to find in machines the willing slaves essential for prosperous and cultivated leisure. Writing at a time when the ignominious annihilation of a hundred million innocent bystanders is a calculated risk, as Wiener admits, this is a very faint hope indeed. Associated with Wiener in the first years of the cybernetic epoch were a number of American mathematicians, physicists, engineers, biologists, psychologists and medical men, and this interdisciplinary texture is, of course, the most striking feature of cybernetic groups. Within a short while of the publication of "Cybernetics" the Josiah Macy Junior Foundation organized the first of ten conferences on this subject, and the proceedings of the last five of these form an indispensable treatise on the widest range of subjects, including computer technology, semantics, brain physiology, psychiatry, artificial organisms and genetics. The factors common to all these topics may be found in the sub-title of the Macy publications: "Circular, Causal and Feed-back Mechanisms in Biological and Social Systems". The phrase that has caught the ear of many listeners to such discourses is "feed-back mechanisms", partly because the notion of feed-back has been invoked to account for a wide variety of natural phenomena and embodied in many artificial devices to replace or amplify human capacity.

To physiologists, feed-back is familiar under the name of reflex action, and the novelty of the concept in engineering is an indication of the youth and naïveté of that discipline. No free living organism could survive for more than a few minutes without feed-back or reflexive action and this truth was embodied in the famous dictum of Claude Bernard: "La fixité du milieu intérieur est la condition de la vie libre". Freedom of action depends on internal stability, and this latter can be attained and maintained only by the operation of forces within the organism that detect tendencies to change in the environment and neutralize or diminish their influence on the internal state. The diagram illustrating this process of reflexive control or homeostasis could represent the mechanism of temperature control in a man or the position of a paramoecium in a drop of water, or the ignition timing in a motor-car or the volume control in a radio – or the water level in a domestic water closet. The first artificial reflexive system to be used in quantity was the rotating-weight speed-governor designed by James Watt and mathematically analyzed by J. Clerk Maxwell in 1868. The verbal description of such devices emphasizes their peculiar interest; in a steam engine with a governor the speed of the engine is controlled – by the speed: in a water closet the water level is controlled – by the water level, and so forth. What then controls what, and for what purpose?

The concept of purpose emerges inevitably at an early stage in such reflections and one of the interesting consequences of cybernetic thinking is that teleology, for so long excluded from biological philosophy, re-appears in a more reputable guise as a specification of dynamic stability. When scientific biology emerged from pre-Darwinian natural history it became unfashionable to ask openly the question "What is this organ or function for?" Most biologists, being at heart quite normal human beings, still thought privately in terms of purpose and causality, but wrote and spoke publicly in guarded reference to functions and associations. The horrifying dullness of traditional scholastic biology is largely due to this superstitious fear of teleology which is in direct conflict with everyday life and makes the study of living processes as dreary as the conjugation of verbs in a dead language. At least in the physical sciences the distinction between the laws of nature and human purpose is useful and explicit. The application of cybernetic principles to biology permits the classification of questions in the sense that in some cases it is legitimate to consider the purpose of a mechanism or a system when it can be shown to have a reflexive component. This criterion implies knowledge of what variables are limited, regulated or controlled and what would be the effect of their release from such control. Thus, in the case of the humble water closet, failure of the reflexive mechanism would leave the tank either empty or overflowing; the water level would seem to be the controlled variable and the ball-cock to control it. But the ball-cock is also controlled *by* the water-level. The flow of water might be a device for regulating the level of the float; our interpretation of the system depends on *a priori* or experimental evidence about the purpose of its design. Strangely enough, the introduction of *purpose* blurs the concept of *causality*. In a simple water tank without a ball-cock arrangement we can assert quite confidently that the flow of water *causes* the tank to fill and overflow; if the tap is shut the tank will *never* fill, if it is open, however slightly, the tank *will* fill and finally overflow. In such a system, the causal relation is clear but the *purpose* is undefined; there is no statement or observation about what the tank is for, and the amount of water overflowing will ultimately be exactly equal to the amount flowing in. Obviously, the tank is a store or reservoir but its purpose is obscure. Now, in the case of the reflexively controlled water tank, the purpose of the ball-cock is to control the water-level, but the circular relation (water-level: ball-cock position: water-level) erases the arrow of causality. This example is so mundane and familiar that the principle it illustrates may seem trivial, but the distinctions between linear and circular processes and between purpose and causality are not limited to gross mechanical devices; consideration of their implications may help to resolve many basic paradoxes of philosophy. Even if cybernetic development is regarded as essentially a branch of engineering rather than philosophy, the appearance of common principles in practical subjects as far apart as astronautics and epilepsy suggests that at least the artificial, academic boundaries between the faculties of physical science, biology, engineering and mathematics can be transcended with advantage and without risk of major error.

The fusion of traditionally detached topics is one of the big features of cybernetic thinking. This often appears in a practical form as the construction of models or analogues, in which some abstract or theoretical proposition is embodied in "hardware". The advantage of this procedure is that the ambiguity of vernacular language and the obscurity of unfamiliar mathematical expressions are both avoided. In the examples already given the assertions in words that "reflexive behaviour gives an impression of purposefulness" or that "stability can be achieved by negative feed-back" are all open to misunderstanding, particularly when translated into a foreign language. Verbal arguments about these propositions usually end with the familiar disclaimer – "it depends on what you mean by . . .". But when these propositions are embodied in working models their content is unequivocal and their implications are open to test and verification. Such models may be called "crystallized hypotheses": they are pure, transparent and brittle. Purity in this sense is achieved by strict application of the principle of parsimony, associated in Britain with the name of William of Ockham to whom is attributed the maxim "entia non sunt multiplicanda praeter necessitatem". In a cybernetic model every component must have a strictly defined and visible function since all material components represent "entities" or terms in the basic theory. The transparency of such models derives in effect from their simplicity and the lack of needless embellishments and decorations; their function is to encourage the scientist to look *through them* at the problem. The third great advantage of a good model is that because of its simplicity and unambiguous design it is semantically brittle: when it fails it breaks neatly and does not bend and flow as words do. In this way the orderly and practical classification of complex phenomena can be based on pragmatic material experiment rather than on a verbal synthesis that may, and usually does, arise from a purely linguistic association.

Unfortunately, one conclusion to be drawn from this is that an article such as this one is really unsuitable as a vehicle for cybernetic ideas since it must commit just the errors that cybernetic thinking tries to avoid. The irony of this situation was seen also in the Cybernetic Congresses organized by the International Association of Cybernetics in Namur; meetings to emphasize common principles were in fact divided into separate sessions dealing with computer technology, industry, education, biology, medicine and so forth, so that only the most casual and mobile delegate could get a true impression of basic unity. Attempts have been made to overcome the deficiencies of conventional channels of communication but none has succeeded, and perhaps the most pressing task for cyberneticians is to work out a means of organising themselves in a new way so that the traditional frontiers between disciplines can be transformed into highways of intellectual commerce. The few text-books and monographs also are essentially traditional in format and presentation though they embody original and provocative ideas. For example, the works of Ashby ("Design for a Brain" and "An Introduction to Cybernetics"), George ("The Brain as a Computer"), Cherry ("On Human Communication"), and the modest but well-balanced "La Cybernétique" of Guilbaud are excellent treatises but all bear traces of the specialist training of the authors and also of their natural deficiencies in the fields strange to them. The fault is not in these individuals but rather in the structure of our Western culture that still demands academic specialization for survival. Even now it is difficult, if not impossible, for a talented young university student to study, for example, physics, mathematics, biology and sociology for an honours degree, and until this is an accepted course cyberneticians will be essentially amateurs in all but one branch of their subject. The fact that it is still impossible to be a professional cybernetician (in the sense that one can be a professional physicist or biologist or mathematician) gives the domain an attractive character of freshness, enthusiasm – and sometimes irresponsibility. It is quite easy to speculate and conjecture about possible machines and even to sketch out a design for them, but quite often the report or rumour of such designs has grown into a legend of a real super-robot. We must remember that it is as easy for a speculative scientist's sketch of an electronic fantasy to become a reputed master-machine as it was for a mariner's fable to establish the sea-serpent. In these days of science-fiction turning to reality before our very eyes there is a real danger of the myth-makers reporting dragons where there are only electronic tortoises.

In the English language at least these rather tiresome misunderstandings have often arisen because of the fashion for using the term "model" for hypothesis or theory or schema. In the literature of cybernetics it is worth examining every reference to a "model" carefully to see whether it refers to a real piece of machinery or merely to a schematic notion. In many cases the absence of a working model is justified by the futility of building a costly machine to perform a function which can already be envisaged clearly in the "paper model". The basic axiom invoked – and one that is indeed fundamental to cybernetics – is that *any function or effect that can be defined can be imitated*. This is taken to apply even to the highest nervous functions of human beings and the power of the axiom is seen when such functions have to be defined.

The emergence of binary arithmetic as a practical implement from the obscurity of Boolean algebra is a significant example of bio-mathematical convergence. One of the great achievements of neurophysiologists in the early part of the 20th Century was the establishment of the All-or-none Law for excitable tissues such as the heart, muscle fibres and nerve fibres. Careful experiment showed that a single cell in heart, muscle or nerve could respond to a stimulus in only one way, by a unit impulse discharge of standard size, duration and velocity of propagation. A stronger stimulus might elicit a larger number of unit impulses but they would always be the same size. If the transmission of nerve impulses is considered as a language then it is a language with only one word – "yes". This poverty of vocabulary has several important implications; the system must be non-linear, or, in physiological terms, has a threshold, a level of stimulation below which no effect is produced and above which the unit impulse appears. The mathematical representation of this relation would be a "step-function" in which there is an abrupt change in an ordinate value at some point along the abscissa. Another implication is that for the impulses in any given nerve channel to convey any specific information, the source of the stimulus must have a predetermined relation to the destination of the nerve channel. Physiologically, the nerve from, say, the eye to the brain, will indicate *light* however and by whatever it is stimulated. The concepts of All-or-none response threshold and local sign are fundamental to neurophysiology and were accepted many years before the corresponding notions emerged in the cybernetic consideration of communication and computation. The difficulties of handling abrupt (theoretically instantaneous) transitions by conventional calculus are well known and were partially overcome in the Operational Calculus of Oliver Heaviside, long before the days of cybernetics, in relation to problems of cable transmission. In Ashby's treatment of more general situations the notion of a step-function was introduced to provide rapid transitions of a complex system from one state to another in order to achieve ultra-stability. In computer technology the greatest single advance was the introduction of the All-or-none Law to arithmetic in the form of binary calculation and in transmission systems too the advantages of unit impulses, modulated in frequency, phase or position were soon realized and embodied in many devices from magnetic storage to satellite monitors. The concept of local sign is found also in computers in which the "address" of a computing element or information store is necessarily included in a programme for computation.

Another factor common to biological and cybernetic systems is large numbers of elements. In the nervous system these are the nerve cells with their processes, the nerve fibres, while in an artificial device they are most likely to be a non-linear component such as a pair of valves or transistors to provide the appropriate unit impulse or binary digit. The provision of very large numbers of elements is again familiar in biology though novel in artificial systems. The cells in the body are counted in milliards and in the human brain alone there are about ten thousand million nerve cells, but this number, vast though it is, is not the significant one in relation to brain function; it is the enormously greater number of ways in which these elements can interact with one another that indicates the scale of cerebral capacity. In artificial machines the number of elements does not yet approach that of the brain cells, but their speed of operation can be very much greater. The unit impulse of a brain cell or neuron lasts about one millisecond and the maximum discharge rate is rarely more than a few hundreds per second. In modern computers the pulses are more than a thousand times shorter and their frequencies of discharge are measured in millions per second. The rate of working of artificial systems can therefore be enormously greater than in living ones and it is commonplace for a calculation that would take a human mathematical prodigy several minutes, to be completed in one thousandth of a second by an electronic computer. In this sense the achievements of artificial systems are super-prodigious and in sad truth our very lives and the survival of human society depend on their speed, accuracy and freedom from distraction. This last requirement, extreme concentration on a specific set of functions, is of course the unique quality of an artificial computer; however brilliant and well-trained, a human brain, even at genius level, has a great number of signals, messages, needs and dreams to compete with the solution of any particular problem. The living system also has another tendency which is minimal or even totally absent in most artificial systems – the tendency to explore and interrogate the environment.

"Spontaneous" activity is generally considered as undesirable in a machine, but this is the principal feature of living animals from the unicellular protozoa to man, and no artificial system can be considered lifelike unless it displays some tendency to explore its surroundings. The illustration of this property was one of the main functions of the first "artificial animal" *Machina Speculatrix* which contained only two neurons, two sense organs and two effectors. The origin of this creature can best be described in terms of my own personal difficulty in envisaging the mechanics of reflexive behaviour. As a physiologist my professional working hypothesis is that all behaviour (including the highest human functions) can be described in terms of physiological mechanism. In trying to establish the principles on which such descriptions could be based I found great difficulty in deciding how complex the *basic* mechanism must be. Obviously a single cell with only one function is trivial and inert unless stimulated. When two are included in the system so that they can interact freely, however, the whole situation is transformed at once. Where the single element system has only two modes of existence, on and off, the two element system has seven – O. A. B. A + B. A $\rightarrow$ B. A $\leftarrow$ B. A $\rightleftharpoons$ B. in which A and B are the elements, which can be on or off and can act on one another or not. Now, in order to couple this system to its surroundings some sensory modalities were necessary and the two that convey the simplest direct information are light and touch. But even when provided with a photo-electric "eye" and a sensitive "skin" the creature was passive unless stimulated and was no more lifelike than a telephone or a pithed frog. In order to give it "life" I provided it with two effectors, a motor to drive it across the ground and another to provide a rotary scanning motion for the eye and the driving wheel. With these additions the behaviour of the model at once began to resemble that of a simple protozoan; it explored all the accessible space, moving toward moderate lights and avoiding bright ones, avoiding or circumventing obstacles. Several other features emerged also (and this is one of the striking results of such essays in the imitation of life). If I had thought more clearly I might have foreseen these effects but I did not, and the fact that my thinking needed the stimulus and demonstration of the real model indicates the limitations of the experimental mind, the practical value of constant interaction between thinking and observing. The first surprising effect of providing the model with a scanning eye was that, when provided with two exactly equal and equidistant light stimuli, it did not hesitate or crawl half-way between them but always went first to one and then toward the other if the first was too bright and close. This was obviously a free choice between two equal alternatives, the evidence of free-will required by scholastic philosophers.

The explanation for this exhibition of what seems to some people a supernatural capacity, is simple and explicit: the rotary scansion converts spatial patterns into temporal sequences and on the scale of time there can be no symmetry. Simple though the explanation may be, the philosophic inferences are worth pondering – they suggest that the appearance of free-will is related to transformation of space to time-dimensions, and that the difficulties that seemed to impress the scholastic philosophers arose from their preoccupation with geometric analogy and logical propositions. Another behaviour mode that surprised me was related to the inclusion in the scanning circuit of an electric lamp to indicate when the scanner was switched off. The system is guided to a light by the disconnection or inhibition of the scanning motor when an adequate light enters the photo cell; sometimes the scanner would jam mechanically and it was hard to distinguish this trivial mechanical disorder from a relevant response. The pilot lamp was added to provide a sort of clinical sign to aid diagnosis or fault-finding. One evening the model wandered out into the hall of my house where there happened to be a mirror leaning against the wall. We heard a peculiar high squeaking sound that the model had never made before, and thinking that it must be seriously unwell we rushed out to help it. We found it dancing and squealing in front of the mirror; it had responded to its own pilot-light, but in doing so had turned the light out, thus abolishing the stimulus so the light came on again and so on. The *positive* feed-back or reflex through the environment generated a unique oscillatory state of self-recognition. If I had had no prior knowledge of the machine's structure and function and had assumed that it was alive I should have attributed to it the power to identify a special class with one member – itself.

Similar but much more complicated effects are seen with a population of several such creatures. Each can "see" the others' lights, but in responding to them extinguishes its own, so that yet another semi-stable state appears in which aggregates of individuals form and dissolve in intricate patterns of attraction, indifference and – when two touch – repulsion. If the boundaries of the working space for this co-operative population are constricted, another state is produced in which contacts between individuals and with the barriers become so frequent that a "population pressure" can be measured. This supervenes quite suddenly and at the same time the responses to light (which are suppressed by the touch stimuli) disappear. The population as a whole is then inaccessible and aggressive, while in the state of free aggregation with less constrictive boundaries individuals could respond independently to a common stimulus; the common goal transforms a co-operative aggregation into a competitive congregation. These complex patterns of behaviour are recounted here to illustrate the value of precise definition and material imitation. If, for example, free-will is thought to be something more than the process embodied in *M. speculatrix* then it must be defined in terms other than the ability to choose between equal alternatives. If self-identification is more than reflexive action through the environment then its definition must include more than *"cogito, ergo sum"*. Considering the exploratory aspect of these models as their most important character the Cartesian proposition should perhaps be re-phrased as *"Quaero, ergo sum"*. Thinking is never easy to define, and it would be hard to exclude a modern computer from the class of cogitating systems, but the faculty of interrogation is a different matter and demands more time, more freedom than we are generally willing to grant our machine-slaves. From the utilitarian standpoint it would be wasteful to programme a computer to ask questions to which the answer is known – the answer might as well be put straight into the programme. This raises the basic problem – how can we decide that a question is worth asking? Here again the most profitable approach seems to be a statistical one – what sort of questions have obtained the clearest answers, and this is a definition of science; the class of exploration which has yielded unexpected but statistically trustworthy results.

The unexpectedness of an answer is an important aspect of its information content. In fact "information" has been defined in terms of its unexpectedness. Even in the analysis of history one may say: "History repeats itself but it is always the unexpected that *matters*." Comparisons have been drawn with the thermodynamic concept of *entropy*, the measure of uniform orderliness of energy, and the statistical analogy may be sound in the sense that in an irreversible phenomenon information and entropy may vary inversely. The relation between energy and information is not an easy one to generalize about, however. Some scientists have hailed the identification of amount-of-information with inverse entropy as one of the most important ideas suggested by cybernetics, but others feel that the cybernetic approach should include particular attention to the actual behaviour of carefully specified systems rather than to algebraic similarities that may arise merely from the limitations of our conventional notation.

The relative modesty of cybernetic achievement (the early claims and promises were certainly over-dramatised) has produced various splinter-groups, some tending toward a more philosophical or at least theoretical position, others concerned with strictly practical application. Among the latter, one of the intriguing titles is "Bionics", a group in which the precedence and possible superiority of living systems is accepted, with the aim of using ideas gained from the study of real living processes to construct artificial systems with equivalent but superior performance. Thus, a man can easily learn to recognize the constellations and thus to find his way by the stars, but a machine to recognize the appropriate patterns, even when they are partly obscured, must be quite complex and carefully adjusted. If we knew more about how we learn to recognize and complete patterns we could make pattern-recognizing machines more easily and these could operate in situations (such as cosmic exploration) where men would be uncomfortable or more concerned with other problems. As we have already emphasized, nothing reveals our ignorance about a phenomenon more clearly than an attempt to define it in constructional terms; the definition of learning as a prelude to making learning machines has been particularly productive in this way. The first point to emerge is that pattern-recognition is synonymous with learning (defining pattern widely as an assembly of events distinguishable from other events, whether in space or time or both).

The first attempt to make a learning machine required specification of the essential steps in this process and these may be classified in four categories: Exploration, Classification, Storage and Comparison. The Exploratory process (which, as in *M. speculatrix*, may involve scanning or spacetime transformation) is essential – even in a sessile computer – for information to be introduced into the system. If a machine or an animal – or a plant – is immobile it may rely on an external agency such as a human operator or a current of water to provide its exploration; in this case the external agency is an operational part of the system. The process of Classification involves a selective mechanism whereby the statistical relation between events is ranked or graded in terms of their conditional probability. These relations may be mutual, sequential, exclusive or inclusive and may range from invariable through occasional to accidental. A mechanism to perform a classification of this sort must accept, as it were, a finite chance of error; a run of accidentally related events will be classified as significant, and even at this rudimentary stage we can have a "sanguine" temperament, would make occasional mistakes and would seem to act on hunches or intuition. Conversely, a high threshold setting produces a "phlegmatic" temperament with a more sceptical attitude to coincidences and an appearance of more "logical" reasoning. The third level of memory stores information that, with respect to a particular assembly of events, the required level of significance has been reached; this memory process operates a gating mechanism whereby the associational significance establishes a new pathway for action. Any single element of the significant pattern can initiate an action appropriate to any or all of the others. In conceptual terms this action is analogous to the experimental testing of the predictions of a working hypothesis whereby the results of the conditional response are compared with the unconditional one; if the comparison confirms the prediction the hypothesis is confirmed. When such comparisons of theory and observation are consistently satisfactory the mechanism has, in effect, established a "natural law" and this may be incorporated with a fourth grade of permanent memory, accessible to a wide range of other sub-systems.

This brief analysis of one cybernetic approach to problems of learning, recognition and decision has several interesting corollaries. One is that, even in the metal, such a system provides ample scope for diversity of temperament, disposition, character and personality. In material practice even very simple machines of this type differ very much from one another, even if they are designed to a close specification, and furthermore these differences tend to be cumulatively amplified by experience. In mass-produced passive machines, such as automobiles, individual differences are treated as faults, and are usually minimized by statistical quality control. Even at this level, however, individual characters do appear and, particularly when they involve a reflexive sub-system, also tend to increase with wear, which is the equivalent of experience in a passive machine.

Another corollary concerns the relation between the overall performance of a cybernetic machine and the functions of its parts. It is obvious, though at first rather surprising, that observation of the behaviour of such a machine may give little information about its internal state. In Ashby's Homeostat there are so many possible connections that no external test will reveal which particular configuration is associated with the state at the time; apparently identical behavioural states may result from a wide variety of internal adjustments. This lack of strict determinism is disconcerting at first, but it is a fundamental inference from cybernetic principles, related of course to the ambiguity of causal direction in a reflexive system referred to above. In more complex machines capable of conditional adaptation and learning the measure of overall performance or "intelligence" gives a very meagre idea of their structure or, if the structure is known, of their functional state. In a population of such machines the distribution of "intelligence" may follow a normal Gaussian curve, as it does in a human population, but this indicates merely that the attribute is multi-factorial and is therefore not a basic or elementary one, however useful it may be as an estimate of capability. Different machines may reach the same standard of performance but may achieve it in quite different ways and one of the uses of cybernetic analysis by imitation is to suggest how the basic learning functions in living beings might be identified more precisely than by observation of input-output performance.

In the models already referred to, learning is considered as a statistical rather than a logical process. Logical reasoning, the ability to solve formal problems by deduction, is considered as a special case in which the level of confidence in the data and rules is extremely high. The ability to perform deductive reasoning is thus merely the net result of many interacting statistical processes which cannot be identified individually without some prior knowledge about the mechanism itself. In the case of an assembly of systems such as CORA, acquaintance with the basic principles of exploration, selection, storage and comparison would suggest experiments to measure the characters of performance at each stage. Considering CORA as a "crystallized hypothesis" of living learning the same procedure could be applied to the study of learning in human beings in the hope of recognizing the basic and essential features rather than their statistical sum.

Studies of this nature are now in progress in several centres of research. One of the important inferences from the simple models of learning is that in the far more complex living systems information from the various receptors (eyes, ears, skin and so forth) must be diffusely projected to wide regions of the brain as a part of the preliminary selective procedure. As a statistical computer the brain cannot make any prior assumption about likely associations and all events must therefore be mixed in the brain impartially and in such a way that their sequence (and therefore possible causal relationship) will be preserved and emphasized. The physiological implication is that stimuli applied to the sensory system should evoke responses in the so-called silent areas; these responses should emphasize the beginning of the stimulus, and the effect of the first of a pair or set of responses should also be preserved for a short time. All these inferences, it should be noted, were derived theoretically from the mechanism of the learning model. All these predictions have now in fact been confirmed in human brains by special physiological methods and even the shape and time relations of the brain responses closely resemble the purely schematic outlines used to illustrate the operation of CORA. The extent of diffuse projection in the human brain is really astonishing; nearly all parts of the frontal lobes are involved in nearly all sensory integration, and with very short delays. The non-specific responses in these mysterious and typically human brain regions are often larger and always more widespread than those in the specific receiving areas for the particular sense organs. They also have another very interesting and important property which the specific responses do not show at all, and this is perhaps one of the most fundamental attributes of intelligent machinery, whether in the flesh or the metal—*habituation*.

If a stimulus is applied monotonously and without variation in background, the diffuse responses in non-specific brain areas diminish progressively in size until after perhaps fifty repetitions they are invisible against the background of spontaneous intrinsic activity, even with methods of analysis that permit detection of signals much smaller than the background "noise". This process of habituation is highly contingent however; a small change in the character or rhythm of the stimulus or in its relation to the background activity will immediately restore the response. Interestingly enough the change needed to re-establish significance may be a *diminution* in intensity; a series of loud auditory stimuli may result in complete habituation after a few minutes but if the same stimulus is given at a very *low* intensity the response may reappear at a high level. The same effect is seen with any novelty in the rhythm or tempo and the conclusion is that, as predicted from the cybernetic model, the brain response to a single event is a measure of its novelty or innovation rather than of its physical intensity or amplitude. This observation probably accounts for the apparently (and literally) paradoxical effect described as "sub-liminal perception". This phenomenon has attracted great interest as a means of "thought control" in advertizing or other propaganda; it involves the presentation of a selected stimulus (such as an exhortation to buy a particular product or vote for a certain candidate) at a level of intensity, or for a brief period, below the threshold of "conscious recognition". Stimuli at "subthreshold" levels have in fact been found to influence the statistical behaviour of normal human beings without their being aware of the nature or moment of the stimulus. These effects are so subtle and could be so sinister that attempts at sub-liminal influence have been banned in many countries by advertizing associations. The paradox of influence by subthreshold stimuli is resolved by consideration of threshold in terms not of intensity or duration but of unexpectedness or innovation. The mechanisms responsible for distributing signals to the non-specific brain regions constantly compute the information-content of the signals and suppress those that are redundant while novel or surprising signals, however small, are transmitted with amplified intensity.

The effects of information selection are even more involved when the signals are part of a complex pattern of association. When the response to a given signal has vanished with habituation it may be restored, not only by a change in the original signal itself but also by association of this with another subsequent signal. The response to the paired signals may also habituate, but if the second signal is an "unconditional" stimulus for action (that is, to gratify an appetite, gain a reward or avoid a penalty) habituation does not occur and in fact the first, conditional response shows progressive "contingent amplification". At the same time the response to the second, "unconditional" stimulus, even if this be more intense than the conditional one, shows contingent *occlusion*. The representation of this situation in real life is quite familiar. In driving an automobile one learns first to avoid obstacles, and this is based on the unconditional withdrawal reflex which prevents us colliding with obstacles in any situation. The next stage is to learn to avoid symbolic obstacles – to stop at the red traffic lights for example. The red light is not harmful in itself, it implies the probability of collision, reinforced by police action – it is a conditional stimulus. The action of stopping at an intersection is determined not by the traffic, but by the light. When the light changes to green, however, the primary defensive action is restored and the real obstacles must be avoided. The same effect is seen in the brain; when a conditional warning stimulus which has shown contingent amplification is *withdrawn* the unconditioned stimulus which has been occluded reappears at full size at once. The brain retains the capacity for unconditional training. A particularly interesting aspect of these observations is the evidence for a dynamic short-term memory system, and here again the resemblance of living processes to those predicted theoretically from cybernetic models is quite startling. In CORA, the third-grade memory, which stores information about significant associations, consists of an electronic oscillatory resonant circuit in which an oscillation is initiated only when the significance of associated events surpasses the arbitrary threshold of significance. This oscillation decays slowly if the association is not repeated or reinforced. Quite recently it was discovered that in records of brain responses to visual stimuli an oscillation appears following the primary response, but only when the visual stimulus has acquired significance, either by irregularity or, more often, by association with unconditional stimuli to which the subject responds with an operant action. These after-rhythms could well be the electric sign of a brain storage system linking the associated stimuli with action. The frequency and phase relations of the after-rhythms are so precise and constant that they may also be operating as a brain-clock, regulating the time-sequence of events in an orderly and effective pattern. The relation of the conditional responses in the brain and their after-rhythms to the intrinsic brain rhythms, particularly the alpha rhythms, is still a challenging problem from which much may be learned not only about the living brain but also about the design of intelligent machines. Wiener, in his book on Non-Linear Problems and in the second edition of "Cybernetics" has approached this question from the theoretical standpoint but the facts are even more confusing than he indicates. In the first place many normal people show no sign of alpha rhythms at all, so whatever function these rhythms mediate must be associated with their suppression rather than with their presence. This is not as unreasonable as it sounds for the alpha rhythms do in fact disappear in states of functional alertness and attention, and the brains of people without alpha rhythms seem to be involved perpetually in the manipulation of visual images. Secondly, the alpha rhythms are usually complex; three or four linked but independent rhythms can often be identified in different brain regions. Third, the alpha waves are not stationary – they sweep over or through the brain. In normal people the direction of sweep is usually from front to back during rest with the eyes shut, but the pattern is broken up and complicated by mental or visual activity. In patients with mental disturbances of the neurotic type the direction of sweep is often reversed to back-to-front, and this effect has been seen for a period of a few months in normal people under severe mental stress. Apart from major disturbances of this sort, the frequency and phase relations of the alpha process are so constant, even in variations of age and temperature, that one is tempted to consider them as ultra-stabilized and to search for a purpose or primary function for them. Any commonplace analogy is probably far too simple and ingenuous to do more than suggest more relevant experiments, but one mechanism that seems to have similar properties is the traffic-operated signal network on a railway or road system. Such signals are in the reflexive or feed-back class since they control traffic but are also controlled by it. In the application of this system to urban road traffic the signals have an intrinsic rhythm when traffic is heavy, so that traffic flows alternately from one direction and then orthogonally. The signals along any main thoroughfare are also synchronized, with a phase-delay, so that for a period the traffic can proceed steadily at a limited pace from one end to the other without hold up. Cross traffic at intersections is held up while the "green" period lasts, but the orthogonal streets may also have phased control-signals so that when the main street "green" is over, the cross traffic also may proceed across many intersections at a certain speed. Now, when the traffic is light in one direction it is wasteful to have the same rhythm and phase of signal as when it is heavy, and the traffic-operated system ensures that a crossing is barred by a red light until a certain number of vehicles have operated the road-pad, when the crossing is opened and the phase-locked sequence is initiated for that street in its turn. When there is little or no traffic the time-sequence will operate alone, providing rhythmic waves of potential inhibition and facilitation which would be seen by a viewer as waves of green and red light sweeping rhythmically along the traffic routes. When the traffic increased again the rhythmic sweep would be interrupted, as the alpha waves in the brain cease, since each vehicle would trigger its own freeway. The effect on the traffic (in the brain the actual volleys and trains of impulses conveying information) would be to divide the chaotic inflow into packets of vehicles alternately stationary, waiting for the green light, and then travelling at a constant speed until the end of the open route. This rather detailed description of a familiar – and sometimes exasperating – scene is presented as an example of the basic principles of traffic control which may be as important in the living brain as in a busy city. Applying the principle of seeking purpose where reflexive relations have been identified, we may ask: What is the purpose of the system – what is actually being regulated or stabilized? In the city traffic the conditions desired are that every vehicle should have an equal chance of reaching its destination at the expected time. We must remember that every vehicle has in effect a *rendez-vous*, an appointment in time and place. Applying the same interpretation to the brain as an information distributing machine, it is equally true that every signal and vehicle, in the form of a train of nerve impulses, has a provenance and a destination, an appointment with some other information-packet. The systematic grouping and routing of these information-packets may well be the function of the intrinsic brain rhythms; their effect will be to limit the maximum rate of action, but avoid complete breakdown by chaotic interaction of cross-streams. In brains that exhibit no intrinsic rhythms the inference would be that all the traffic control devices are being traffic-operated and this system over-rides the time-sequence processes, while in brains with persistent alpha rhythms the intrinsic time-cycles are pre-potent and see the emergence of artificial superstitions based on accidental occurrences and transient significance. The Storage process, whereby information about selected significance is preserved for further action, has aroused great interest since in the case of the living brain the actual physical space available for storage seems so small compared with the amount of conditional information in the average human memory. We should recall, however, that the number of permutative combinations of the neurons in a human brain is unimaginably great and if we invoke as well the potential storage capacity at the molecular, intra-cellular level the paradox is reversed; human memory could perhaps be even more extensive and precise than it usually is. Apart from the size or scale of the memory-store, an efficient learning mechanism should have ready access to its significant traces, and this problem too has attracted much attention, both in neuro-physiological research and machine design. On general grounds of efficiency, economy and elegance it seems unlikely that any single process or mechanism can subserve all the functions of memory. In most artificial machines and probably in higher nervous structures several grades and types of memory are involved, operating on quite different principles. For example in CORA (the Conditional Reflex Analogue designed to endow *M. speculatrix* with a rudimentary capacity for learning by association) there are three types of storage. The first merely preserves the information that an event has occurred for a few seconds, in case it turns out to be significant in relation to a succeeding event. If this should occur, such an event would be classified, in Pavlovian terms, as a *Conditional* stimulus. The second grade of memory stores information about the relation of pairs or patterns of events that have occurred in association. The rate at which the information in this store is accumulated depends upon the frequency, regularity and contingency of the events concerned, but has no influence on other processes until the level of storage has reached an arbitrary threshold of significance, determined by the level of probability at which the system is expected to work. If the threshold is low the system would all signal-vehicles are constrained to follow this procedure. We know from our acquaintance with actual traffic systems in various cities that both the strict time-phasing and the traffic operated system can work well, and that various types of combination of both also work. We also know that above a certain traffic density any of these systems may break down and that failure-to-safety can be assured most easily by having all controls near the centre of the jam set to red while the peripheral traffic filters away. Bearing in mind that in the brain all these controls and filters are likely to be statistical rather than absolute, we may lengthen the conjecture to include the sweep-reversal seen in neurotic patients and normals under stress as a failure-to-safety device, holding up neurotic traffic but reducing the probability of collision or futile encounter.

These comparisons illustrate how observations on systems as diverse as the dark world within our skulls, the flashing lights of a busy city, the meanderings of an artificial animal and the lonely terror of a mental ward may illuminate one another to provide a general idea from which each in turn may benefit. Cybernetic claims have been derided because in many cases they seem to provide merely blinding glimpses of the obvious, and indeed the discoveries and inventions in cybernetic engineering have often been anticipated either by the evolution of living systems or by common sense. Even in the most trivial situations, however, the cybernetic approach can both unify apparently remote concepts and dissolve away the aura of transcendental influence that surrounds such terms as "intelligence", "purpose", "thinking", "personality", "causality" and "free-will". We are still in the age of cybernetic amateurs, who are content to test their skill with machines that play games and imitate the simplest vital functions. The next generation of professional steersmen – who are already maturing in the great technical Institutes of many countries – will offer even more profound and revolutionary principles and contrivances to technocratic culture. One of the most significant struggles will certainly be over the cybernetics of cybernetics in society – who is to control whom and with what purpose?

Democratic society as defined in the West (that is, universal suffrage, secret ballots, two or three political parties, public debate, decision by majority in two houses, moderating influence of President or constitutional Monarch) is an excellent example of a cybernetic evolution, perhaps more steersman-like than even Ampère would have imagined. In some ways Western democracy is remarkably sophisticated. The suffrage system (one man – one vote and election by bare majority) may be defined as a binary opinion amplifier with statistical stabilization. However strong and widely held an opinion may be, only one candidate can be elected in any constituency. On the other hand the coupling to the legislative assembly and the reflexive action of the legislation on the voters is generally slightly positive, leading to a slow oscillation of party majorities. The classic phrase "Government of the people, by the people, for the people" is a precise embodiment of the cybernetic axiom that in a reflexive system causality disappears as purpose emerges. One of the most delicate adjustments in Western democracy is the timing of elections to match the natural period of oscillation. The American Constitution is a perfect example of phase control, since the President is elected every four years and one third of the Senate every two years. This constitutes an introduction of a small component at the second harmonic frequency of the pulse repetition-rate, leading to an effect similar to rectification of an alternating pulse wave-form. Politically, the effect of this is to diminish the probability of violent swings of policy from one extreme to the other; a period of relative tranquillity corresponding to two or four presidential terms will tend to be followed by a marked deflection in one direction but the opposing swing to the other side will again be diminished by the second harmonic rectification. This effect is acknowledged in practice by the traditional conflict between Executive and Legislative which is of course quite different from the system in other countries where the Prime Minister is necessarily a member of the majority party and the President or Monarch has a minimal influence in policy decisions. The ingenuity of the American Constitution reflects the cybernetic insight of its originators and its survival with only minor amendments since 1787 indicates its basic stability. If the full cybernetic implications of this unique specification for dynamic equilibrium had been realized at its inception, even the genius of Benjamin Franklin might have recoiled from the complexities of its checks and balances.

At the other extreme of political organization, the autocratic tyranny or dictatorship also displays cybernetic qualities of universal interest. In place of an elected assembly the dictator must rely on a spy network to provide information about popular feeling and economic trends. As long as the political police are unobtrusive and act merely as opinion samplers the system can be stable since the autocrat can regulate his edicts by reference to popular opinion which in turn is influenced by the edicts. Serious instability in an autocratic régime arises when the political police actively suppress expressions of opinion by arrest and mass execution. This destroys the sources of information and ensures an explosive evolution. The principle of innovation applies here as it does in the brain; in political evolution it is the unexpected that matters and since by definition the unexpected will appear first on a small scale, minority views must be constantly sampled since among them will be found the earliest harbingers of future change. In the brain, the responses evoked by novel stimuli involve no more than one per cent of the available nerve cells, but this minority response is a clear indication of a likely trend in behaviour. Similarly in the political system the majority is always *wrong* in the sense that it preserves the impression of the past rather than a plan for the future. The Autocrat must therefore take great care that the ears of his henchmen are tuned to dreams and whispers. This suggestion, that the majority is always wrong, has important implications for electoral democratic systems also; minority views are represented in free election, but if these result in the subdivision of parties into many splinter-groups the operation of the legislative assembly becomes sluggish and inconsistent. The more effective arrangement is for the growth of a minority view to influence the bias of the opinion amplifier, that is to modify the policy of a major party. In comparing social with cerebal organizations one important feature of the brain should be kept in mind; we find no boss in the brain, no oligarchic ganglion or glandular Big Brother. Within our heads our very lives depend on equality of opportunity, on specialization with versatility, on free communication and just restraint, a freedom without interference. Here too local minorities can and do control their own means of production and expression in free and equal intercourse with their neighbours. If we must identify biological and political systems our own brains would seem to illustrate the capacity and limitations of an anarcho-syndicalist community, perhaps inspired by a decadent symbol of sexual potency.

The social implications of cybernetics in society are not limited to conjectural parables and analogues. Social stability and evolution depend on the communication to each succeeding generation of the accumulated knowledge and experience of the society – on education. The construction of machines that can learn has its corollary in the design of machines to teach. In the learning situations outlined above it was assumed that the organism or the robot was compelled to find out for itself which behaviour patterns were safe and useful and which dangerous and irrelevant. This is perhaps the most interesting case of learning but, except for a few experimental animals in psychological laboratories, it is rare in natural conditions. In fact, animals above the level of birds and reptiles depend very much for their whole normal maturation on close and varied contact with others of their own species. Education, the systematic and repetitive communication between generations, has roots in the reproductive physiology of mammals and is basically effective in preserving established rules and customs; the notion that education should encourage and inspire originality and innovation is a modern development and conflicts directly with its physiological origin and traditional social techniques. A human teacher inevitably tends to mould his class in his own mental form; his prejudices and limitations are duplicated as truly as his wisdom and inspiration. The introduction of machines to the classroom, not as mere aids to demonstration, but as active channels of communication opens new vistas for education.

In the first place the programme of a teaching machine must satisfy very rigid criteria of veracity and intelligibility. In some systems each step in an argument is so small as to be almost imperceptible and the student has the satisfaction of regular faultless performance at each stage. In another system each statement or suggestion is followed by a set of numbered alternative answers, from which the student selects the one that seems most likely or plausible by pressing an appropriate button. Each button causes the machine to switch to another page, as it were, on which the mechanical tutor deals with the student's answer. If it was correct in every particular the proposition is confirmed and instruction proceeds to the next step; if it was wrong the text explains again the argument where the error occurred with particular reference to the source of the particular mistake, according to whether it was due to a misunderstand, a disagreement, a careless slip or to total incomprehension. The question is put again, perhaps in another way, and by a series of progressive corrections the student returns to the main line of discourse. Thus the student controls the progress of the instruction by which he is himself controlled; the reflexive loop so formed provides a sense of personal purpose achieved only in very small classes or individual tuition. Obviously the design of such a course, even in the most elementary subjects, demands a fresh and unprejudiced view of each topic since the likely difficulties and queries must be accepted as a part of the subject-material. The course taken through the subject by any particular student may be direct or devious, but there is little chance of completion without comprehension. Successful programmes of this sort have been in use for some years – they cover many subjects as diverse as trigonometry, contract bridge and contemporary poetry. The results have been uniformly good in the sense that, on the average, students reach a particular standard of attainment in about *half the time* needed with class teaching. Even this figure does not indicate the second great advantage of machine teaching; the scatter of study-times can be much wider with machine teaching than with human instructors. The fast, talented worker can complete the course in a matter of days rather than weeks; the slower, duller one in months, without loss of self-confidence or prestige since the errors are made privately, without reprimand or humiliation. The third great advantage of machine instruction is that it liberates human teachers from the soul-destroying task of repetitive didactics. With the essential basic routine of factual indoctrination delegated to an inanimate intermediary the teacher can devote his vocational talents to the personal, human task of encouragement, reassurance and explanation; his image is not deformed for the student by association with the tedious and childish phases of elementary drill.

In a society irreversibly committed to increasing technical sophistication – or extinction – every means must be used to consolidate and amplify the diversity and delicacy of human relations. The shameful lesson of history is that where personal relations could propagate the rare flowers of art and discovery, they grew in a soil enriched with the blood and sweat of countless slaves. Even if it be a faint hope, hope we must that future generations will look back on the humble creatures of our laboratories as the ancestors of their servile regiments of intelligent machines.

Prototypic Organisms V. Drosophila

Michael Ashburner

The famous "rediscovery" in 1900 of Mendel's 1865 paper "Versuche über Pflanzen-Hybriden" led to the foundation of a new branch of biology – genetics: "It is no hyperbolic figure that I use when I speak of Mendelian discovery leading us into a new world, the very existence of which was unsuspected before" an evangelical Bateson told the audience of his inaugural lecture in Cambridge in October 1908. Looking back over the literature of the first ten years of genetics one is impressed by the diversity of animals and plants studied in the essentially successful attempt to prove the universality of Mendel's Laws. By 1910 much of the terminology of modern genetics was established; the concept of alternative *alleles* of a single factor by Bateson in 1902, *mutation* by de Vries in 1901, the word *genetics* itself by Bateson (1906), *gene* to denote the unit of inheritance by Johannsen (1909) and the distinction between *genotype* and *phenotype* recognized by Johannsen in 1911. Analysis of the inheritance of flower colour and pollen shape in sweet peas led to the discovery of *linkage* by Bateson and Punnett in 1905 and of colour forms in the moth *Abraxas* to the discovery of sex linkage by Doncaster in the following year.

Yet the nature of Mendel's "Merkmal", Bateson's "factors" and Johannsen's "genes" remained enigmatic; they could only be studied at the level of their behaviour in breeding experiments. Despite suggestions that the genes were in some way connected to the chromosomes many geneticists remained sceptical. Bateson wrote in 1909 "much that is known of chromosomes seems inconsistent with the view that they are the sole effective instruments in heredity" and saw no reason to alter this statement in the 1913 edition of his "Mendel's Principles of Heredity".

The introduction of *Drosophila* to genetical research in 1910, essentially the responsibility of T. H. Morgan, was to lead within three years to a rigorous proof of the chromosome theory of heredity and was to bring genetics a standard of sophistication and elegance in experimentation that it had hitherto lacked. The reasons for the revolution that this small fly caused are complex; Morgan's choice of *Drosophila* was exceptionally fortunate, just how fortunate was only slowly to become apparent. Further, Morgan, and his trio of brilliant students Bridges, Muller and Sturtevant, established in the "fly room" at Columbia a spirit of co-operation and encouragement that led to the rapid spread of *Drosophila* to many other laboratories and to an intensive study of the genetics and biology of this fly which continues without loss of vigour to this day.

Drosophila melanogaster is the most widely-studied species in a family of species that is estimated to possess some 2,000 members. It is a common sight in houses, especially in the autumn, where it is attracted to fruit, decaying vegetables or to alcoholic drinks. Together with *D. busckii* and the larger *D. hydei* and *D. funebris*, *D. melanogaster* has been considered a "domestic" species; these species are found world wide in association with man. This can lead them into some rather bizarre habits. *D. busckii* was discovered by Coquillett breeding on a formalin-preserved human breast in a Paris museum and has been recorded as breeding on human corpses in Central America. Most species of the family are more selective in their habits however. Many feed on yeasts or other fungi, on fruit or on plant saps. There are groups of species, for example that which is centred round *D. flavopilosa* in Chile, whose larvae feed on the pollen of flowering plants, or like the Scaptomyzids of England whose larvae "mine" plant leaves. In the West Indies *D. carcinophila* has a commensal association with land crabs, and in Hawaii the larvae of the genus Titanochaeta are parasites on the eggs of spiders.

In the laboratory the geneticist is usually more conservative than his flies. The fermenting banana mash of the earlier workers has been replaced by the more prosaic food of cornmeal, molasses, yeast set with agar, and the flies are usually cultured in half-pint milk bottles or smaller glass vials. At a temperature of 25°C the life cycle of *Drosophila melanogaster* takes from 9 to 10 days. The small (0.5mm) eggs hatch within 24 hours of laying into larvae which feed and grow rapidly for four days. During this time they moult twice, and finally transform into an immobile pupa. Within the protection of the pupal "case", in reality the tanned skin of the last larval stage, the larvae commence their dramatic metamorphosis into the adult fly. Most of the tissues and organs of the larvae break down and adult organs and tissues are differentiated from small nests of cells, known as imaginal discs, which have been lying almost dormant during larval development. The process of adult development takes about four days. Then the adult fly breaks out of the pupal case, expands its wings, dries itself and is ready, within a few hours of emergence, to restart the cycle. Under favourable conditions a single pair of *Drosophila* will produce at least 1,000 progeny. *Drosophila melanogaster* thus fulfils some of the basic requirements for a convenient laboratory organism. It is very easy, and cheap, to culture, it breeds rapidly, producing large numbers of offspring. Furthermore the flies are very readily anaesthetized for examination, the sexes are easily distinguishable by virtue of the black pigmentation of the abdomen in the male and other characters, and the adults will not mate for several hours after hatching so that by regular collection of flies from cultures virgins are obtainable. This is very important as much genetics requires making defined crosses between flies of known constitution.

Most of these specifications were known to Morgan. He also knew that the chromosome number of *Drosophila melanogaster* was low; there are only four pairs of chromosomes. This we can contrast to the 28 pairs in the silkmoth *Bombyx mori* (the only insect to rival *Drosophila* as a "genetic" organism; Toyoma commenced silkworm genetics in 1906), the 23 pairs for man and the 39 pairs for the chicken. The low chromosome number of *Drosophila* immensely simplified its genetic analysis. What Morgan did not know at the outset of his studies with *Drosophila* was that crossing over of the chromosomes was absent from males, that *Drosophila* was tolerant to considerable abnormality of chromosome number, that certain chromosome aberrations were common in wild populations of *Drosophila*, that the larval salivary glands possessed giant chromosomes allowing an almost direct visual inspection under the microscope of the genetic material and that the biology and distribution of *Drosophila* were to make it so suited to both evolutionary and developmental studies. I will explain and elaborate these points in the following paragraphs.

The first major contribution of *Drosophila* to genetics was the conclusive proof of the chromosome theory of heredity. In the main this was achieved by Morgan, Bridges and Sturtevant in the period 1910 to 1914, although ample supplementary proof was to become available over the next twenty years. Bridges was interested in certain exceptions to the usual rule of sex linked inheritance. Normally, as discovered by Morgan working with the first mutant of *Drosophila*, white eyes, males transmit sex linked factors only to their daughters while females transmit to both their daughters and their sons with equal frequency. This is to be expected if the females possess two X chromosomes and the males but one and if the factor for white eyes is linked to this chromosome. Homozygous white eyed females when mated to red eyed males produce sons all with white eyes and daughters all with red eyes. All the progeny from white eyed males mated to red eyed females are red eyed but the daughters are able to transmit the white eyed factor to half of their sons. Occasionally exceptions to this "criss cross" mode of inheritance are detected. White eyed males give rise to white eyed sons when mated to red eyed females or white eyed females to white eyed daughters when mated to red eyed males. Bridges discovered that these exceptions were due not to renewed mutation as the factor for white eyes, as originally thought by Morgan, but to an abnormal transmission of the sex chromosome by these flies. In detail this phenomenon is known as non-disjunction and is the result of the failure of the sex chromosomes to separate during meiosis; in the case of the female eggs with both of her sex chromosomes, instead of just one, are laid. The precise correlation of the cytological behaviour of the X chromosomes, and the inheritance of the white factor in these experiments was the first conclusive evidence in favour of the chromosome theory.

Great support for the theory was to come also from the discovery that all the mutants in *D. melanogaster* could be assigned to one of just four linkage groups, corresponding to the four pairs of chromosomes, and with Sturtevant's brilliant realisation that the frequency of crossing over between mutants of the same linkage group could be used as the basis for the construction of linear genetic maps of the chromosomes. The correctness of this approach was shown by the demonstration that chromosome aberrations resulting from the exchange of chromosome material between different chromosomes lead to a corresponding change in the linkage relationship of mutants on the chromosomes involved.

With the discovery of the giant chromosomes in the salivary gland of *Drosophila* larvae in 1933 there was opened a marvellous opportunity to correlate linkage maps of mutants with the chromosomes. These giant chromosomes possess a very characteristic pattern of cross bands which allow the ready identification of any chromosome region. Bridges demonstrated that each band of the giant chromosome probably represented a single gene and that the genetic map deduced from breeding experiments was precisely colinear with the map produced from the analysis of the banding of the giant chromosomes.

This is not the place to review the history of *Drosophila* genetics. However some of the outstanding contributions of *Drosophila* to genetics, especially during the period of 1910 to 1940 might be mentioned. With the increasing number of laboratories investigating the genetics of *Drosophila* the number of mutants available increased greatly. By the time of their 1925 review of this subject Morgan, Bridges and Sturtevant were able to list about 400 mutations. Yet neither the nature of mutation nor techniques for the induction of mutants were understood. In 1927 Muller anounced his discovery of the induction of mutations in *Drosophila* by X-rays. This discovery was aided enormously by the fact that Muller had introduced specially constructed chromosomes (known as balancers) which permitted the unambiguous screening of the progeny of treated flies for induced lethal mutations. This technique, and more sophisticated derivatives from it, are still in use in mutation research today and were used in the discovery of the mutagenic effect of certain chemicals in 1942. The ability of X-rays to induce mutation was not only of extreme theoretical importance but also led to the availability of numerous new mutations and chromosome aberrations for other studies.

Although it is a consequence of the chromosome theory of heredity that crossing over between genes must involve the exchange of material between the chromosomes themselves, understanding of the nature of this process was greatly aided by research in *Drosophila*. In 1909 Janssens had proposed the chiasmatype theory that genetic recombination occurred during meiosis at the time the chromosomes had reduplicated and that the chiasma observed between homologous chromosomes by the cytologist represented the consequence of this exchange. Using a special X chromosome in which the two X chromosomes of the female were attached to each other and behaved as a single unit, rather than behaving as separable elements, it was shown in 1925 that crossing over must occur following chromosome duplication during meiosis and six years later, again by the use of artificially constructed chromosomes, that genetic recombination was accompanied by a parallel exchange of material between the chromosomes.

The "construction" of chromosomes in *Drosophila* sounds like a job for a rather specialised engineer; indeed it is – albeit he will be a geneticist. Purely by breeding and selection of special strains of *Drosophila*, often with the help of an X-ray machine to induce mutation, the *Drosophila* geneticist now has a very considerable control over the genetic architecture of his flies. Many extraordinary chromosomes have been constructed, especially by Muller and

Sturtevant and their students, either for their intrinsic interest or for the solution of some special problem.

For example the normal X chromosome of Drosophila is a rod-shaped element. But it is possible to construct an X chromosome which is a ring; this possesses one very useful property, it is unstable during mitosis and is frequently lost. A fly starting life with one normal X chromosome and one ring X chromosome will lose the ring from certain cells during development. Once lost there is no way in which a cell can regain its ring so all of the cells descending from the original cell to lose the ring X will also lack this chromosome. If suitable genetic markers are placed on the two X chromosomes the cells that have lost the ring X can be identified by their phenotype. Such a technique can be used to map the surface of a fly with respect to areas of common cellular descent. Furthermore, as Bridges was to show in 1921, sex determination in *Drosophila* depends upon the "balance" or ratio between the number of autosomes and the number of X chromosomes. If this ratio is one the fly will be female, if it is one-half then male. In the situation just described cells that have lost one X chromosome will be male and will express the male character on areas of the fly that are sexually dimorphic. They will be gynandromorphs. Unlike vertebrates the insects (with a few exceptions) lack sex hormones and the phenotype of any single cell is autonomous depending upon its own genetic constitution and not on some overall hormonal influence. Similar studies can be made concerning other aspects of the phenotype of the fly. For example, if we make a gynandromorphic fly mosaic for genotypically red eyed cells and genotypically white eyed cells, will these phenotypes be expressed autonomously or not within a single eye? Or what about a mutant that affects the pattern of bristle distribution on the fly? Will cells homozygous for such a mutant when surrounded by cells heterozygous in a mosaic in a single fly express their phenotype or the phenotype of the mass of the surrounding tissue? Many such experiments have been performed and as a rule the mutants are found to be autonomous in their expression. However there are exceptions and one, involving a mutant eye colour, is important for the history of the development of genetics.

As long ago as 1909 Bateson in his "Mendel's Principles of Heredity" had discussed the nature of the primary gene product. He is worth quoting: "what the physical nature of the units (of heredity) may be we cannot yet tell, but the consequences of their presence is in so many instances comparable with the effects produced by ferments (i.e. enzymes), that with some confidence we suspect that the operation of some units are in an essential way carried out by the formation of definite substances acting as ferments".

Bateson was, of course, fully cognisant of the work of Garrod who had suggested that the inherited disease of man, alkaptonuria, was the consequence of the absence of an enzyme which degrades homogentisic acid. In England Haldane and others at the John Innes Institute were clearly very close to propounding the "one gene-one enzyme" theory as the result of their work on the inheritance and biochemistry of flower colours. Yet their work was terminated by the outbreak of the second world war and it was left to Beadle and Tatum to spell out the hypothesis and collect the glory.

The background of Beadle and Tatum's work, which was with the bread mould *Neurospora*, lay in the experiments of Beadle and Ephrussi with *Drosophila*. They extended Sturtevant's earlier investigation of the autonomy of eye colour mutants by the introduction of a novel technique. They transplanted the imaginal discs for the eye between larvae of different mutant strains of *Drosophila*. The transplanted eye disc grew and metamorphosed along with its host and the fully formed eye could be recovered floating in the abdomen of the adult host. The eye discs from most eye colour mutants developed autonomously when allowed to develop in the milieu of a wild type host. But two mutants did not. These were the eye colour mutants vermilion and cinnabar, and their discs developed the wild type colour when transplanted into wild type hosts. When vermilion discs were transplanted into cinnabar hosts these too developed the wild type pigmentation. But when the reciprocal transplantation of cinnabar discs into vermilion hosts was studied then it was found that the cinnabar discs behaved autonomously. Beadle and Ephrussi concluded from this experiment that the blocks in pigment formation in the two mutants must be at different steps in the pathway of pigment synthesis and that the block caused by the vermilion mutant must precede that caused by the cinnabar mutant. This experiment served as a model for the subsequent work of Beadle and Tatum on the genetic control of metabolism in *Neurospora*.

It must not be thought that all research with *Drosophila* is restricted to the laboratory. Ever since Sturtevant's interest in the taxonomy of *Drosophila* there has been considerable attention paid to the biology of *Drosophila* and studies with these flies have made a very important contribution to evolutionary biology. Three groups of studies stand out; those of Dobzhansky's group initially with *D. pseudoobscura* and later with the *Drosophila* fauna of South America, those initiated by Patterson in Texas on the evolution of *Drosophila* species and those of the combined University of Texas-University of Hawaii group on the *Drosophila* fauna of the Hawaiian Islands. I will only consider here the last-mentioned example as it represents an extremely interesting situation.

In 1945 it was pointed out that the *Drosophila* fauna of the Hawaiian Islands appeared to be especially rich. As the result of the joint University of Texas-University of Hawaii study over the last ten or so years it is now apparent that there are about 700 species of *Drosophila* native to the islands. The vast majority of these are endemic; that is to say they are found only in the Hawaiian Islands. These 700 species represent perhaps one-third of the world's known Drosophilidae. This represents an extraordinary evolutionary phenomenon especially when it is realised that the Hawaiian Islands are, geologically speaking, extremely young. The oldest islands are probably only 5 million years old, and the youngest perhaps 1 million years. The islands are volcanic and are, and have always been, separated from the nearest continental land mass by about 5,000 kilometres. There is considerable evidence that there has been only one or two colonisations of the islands by Drosophilids and that the subsequent adaptive radiation of this group has occurred within this relatively short time period. The Hawaiian *Drosophila* fauna possesses many unique features. Here the normally clear-cut division of the family into its Scaptomyzid and Drosophilid branches is obscured; many species apparently overlap between these divisions. Here the Drosophilids often show extreme sexual dimorphism, the males possessing many striking morphological structures. These structures – involving the mouthparts, legs, eyes, etc. – are utilised in the courtship behaviour of the flies. Unlike *Drosophila* found elsewhere in the world the Hawaiian *Drosophila* do not court or mate at their feeding sites. They mate at some special site away from the feeding site and here the males of the species establish a territory, warning off other males or unreceptive females, and waiting for the appearance of a receptive female of the same species. This "lek" behaviour of the Hawaiian Drosophilids may have led to an intensification of sexual selection and the evolution of the specialised male modifications. The "reason" why the Hawaiian species evolved lek behaviour, spatially separating their feeding and mating sites, may have been the high predation, especially by birds, at their feeding sites.

Many of the Hawaiian species are found only on particular islands of the archipelago. By a very detailed analysis of the banding pattern of the giant salivary gland chromosomes very convincing phylogenetic trees have been constructed relating many of the different species and to provide evidence concerning the frequency and nature of inter-island colonisations. It is thought that the relative isolation of populations within the different islands, coupled with a low but certain amount of genetic mixing of these populations as a consequence of migration, was one of the factors leading to the explosive evolution of this family.

To return to laboratory studies, *Drosophila* is now a favourite animal for studies that might be rather vaguely called problems in developmental biology. This term covers a multitude of sins but basically the problems of interest are these. It is a dogma that, with a few well-defined exceptions, the genetic complement of each and every cell in an adult organism is identical. They are all derived by cell division from a single cell – that of the fertilized egg. Yet the adult organism displays a variety of cellular phenotypes. Again it is a working assumption that these diverse cellular phenotypes result from variable gene activity during development. There are perhaps two basic problems; how this variable activity of the genes is controlled and how this is translated into the particular spatial organization of the cells and tissues which make up the organism. I will quote two examples of research now in progress which are attempting to answer these problems. They both use *Drosophila* as their "tool", mainly because the preceding 60 years of genetics has made it an organism which can be manipulated genetically with a sophistication unknown for any other multicellular organism. They differ in the level of their analysis in that the former is studying the temporal control of gene activity at a rather direct level, while the latter is studying basically the consequences of gene activity as seen in the developmental fate and behaviour of groups of cells.

I have already alluded to the giant chromosomes of the salivary gland of the larval *Drosophila*. In the 1930s Bridges deduced that the bands of the polytene chromosomes "represented" the genes of the classical geneticists. We now know this to be almost literally true. Genetic information is encoded in the sequence of bases in the DNA and the chromosomes themselves consist of the DNA and associated proteins. We know also that an essential intermediate step in the expression of this genetic information is the transcription of DNA sequences into a RNA transcript that might be later read by the cellular machinery and translated into a specific protein. Normally the process of transcription can only be analysed and studied by biochemical techniques. On account of their great size, however, transcription of particular DNA sequences in the salivary gland chromosomes is observable microscopically. A band in the process of transcription undergoes a remarkable transformation into a swollen structure known as a puff. As realized in the early 1950s the study of puffing and of its properties enables a direct analysis of gene activity during development to be made. A study of the particular bands involved in puffing activity at different stages in development shows that each stage is characterized by a very specific pattern of puffed bands and that as development proceeds this changes in a regular manner. It is especially noticeable that the periods of moulting during larval development are periods of intense puffing activity and we now know that this activity is under the same hormonal control as moulting itself. Indeed it is possible experimentally to induce prematurely specific sequences of puffing activity by the premature administration of the moulting hormone either to the whole larva or to organs cultured in the "test tube". Analysis of the factors responsible for the initiation of puffing at particular bands and the factors responsible for the temporal sequence of puffing at different band sites is proceeding in the hope that this may better our understanding of the mechanism of the control of gene activity during development.

The second experimental "system" I wish to describe was developed by Hadorn and is an analysis of the development of the imaginal discs of *Drosophila*. The larvae of *Drosophila* possess several well-defined groups of relatively undifferentiated cells. Following pupation these develop into the structures of the adult fly. Each imaginal disc of the larva is destined, during normal development, to give rise to a specific organ or part of an adult; for example a wing, leg or eye, or the gonads or a region of the gut.

Hadorn showed that an imaginal disc could be transplanted from a larva into the abdomen of an adult fly. Here it would grow, indeed it would grow indefinitely within the constraints exercised by its host, but it would never differentiate. Yet if it was transplanted back again into a larva it would differentiate along with the metamorphosis of its second host. What Hadorn did was to take a single imaginal disc, say that determined to develop into the external genitalia, and culture it generation after generation in a succession of adult hosts. Every generation the disc would be divided, one fragment would go back into an adult to continue the line and another bit would be transplanted into a larva to test its potential for development. Hadorn was interested in the question whether, with successive culture generations, the disc would continue to differentiate, on implantation into a larva, into the structures for which it had been originally determined. The answer to this question is a qualified yes. For several generations the test implants would develop only into these original structures, but after some time it was found that disc fragments differentiated into new structures on test implantation. They became "transdetermined" in Hadorn's terminology; instead of male genitalia they developed into wing or leg tissue. These transdetermined disc lines might then themselves become transdetermined into yet a third type of structure. Analysis of many such experiments showed that transdetermination could not be accounted for by a process akin to mutation; its frequency was far too high and it occurred in too non-random a manner for this. Further there is evidence that the trans-determinative event occurs not in a single cell but in a group of associated cells at the same time. The nature of this event is still obscure; its elucidation will certainly tell us much about the original determinative event and much about the nature of the control of the expression of the cellular genotype during development.

This survey of *Drosophila* has attempted to place this organism within the context of the body of genetics and biology. Inevitably it is a too sketchy and idiosyncratic approach. Yet I hope that it will contribute to an understanding of why this fly still dominates the interests of many research scientists and contributes to our understanding of many biological phenomena. I am conscious of all the things that I have omitted to cover, and also of my debt to the published literature. This is especially so to Sturtevant's "History of Genetics". If Sturtevant's name has frequently been mentioned in these pages this is due to his major contributions to the field of *Drosophila* research and I wish this article were a more fitting memorial to him. I append a short list for further reading and a glossary. The latter draws freely on "A Glossary of Genetics and Cytogenetics" by Rieger, Michaelis & Green.

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GLOSSARY

allele: one of two or more alternative forms of a gene.

chiasma: the microscopically observable interchange between homologous chromosomes in meiosis (see crossing over).

chromosome: the physical bearer of the hereditary material. Composed of DNA and associated proteins. They are found within the cell nucleus.

crossing-over: the exchange of chromosome material between homologues; leads to the reassortment of the genetic material from parent to offspring (see recombination).

differentiation: the formation of differences between cells or populations of cells during development.

gene: the basic unit of inheritance.

genotype: the total genetic information of an organism or cell (see phenotype).

gynandromorph: a sexual mosaic; part male and part female.

heterozygous: having different alleles at the same genetic locus (see homozygous).

homologues (homologous chromosomes): chromosomes in which the same gene loci occur in the same sequence. A normal diploid contains n pairs of homologous chromosomes. For *D. melanogaster* $n=4$, for man $n=23$.

homozygous: having identical alleles at the same genetic locus.

linkage: the association in inheritance of certain genes (and therefore the phenotypes they control) due to their localisation on the same chromosome.

meiosis: a process involving two successive divisions of a nucleus that precedes egg or sperm (i.e. the gametes) formation. Results in the halving of the chromosome number so each gamete possesses only one of each homologous pair of chromosomes.

mutant: a heritable variation arising from the standard "wild type" or "normal" state.

mutation: a heritable change in the genetic material.

phenotype: **the external appearance and the properties of an individual. Results from the expression of that individual's genotype interacting with its enviroment.**

recombination: **an event (e.g. crossing-over) leading to new associations of genes in their transmission from parent to offspring.**

sex chromosomes: **a pair of chromosomes, that may be only partially homologous, which are differentially represented in the two sexes. In normal *Drosophila* the X chromosome is present twice in females and only once in males. The Y chromosome is normally only found in males.**

sex linkage: **the location of certain genes to the sex chromosomes (q.v.).**

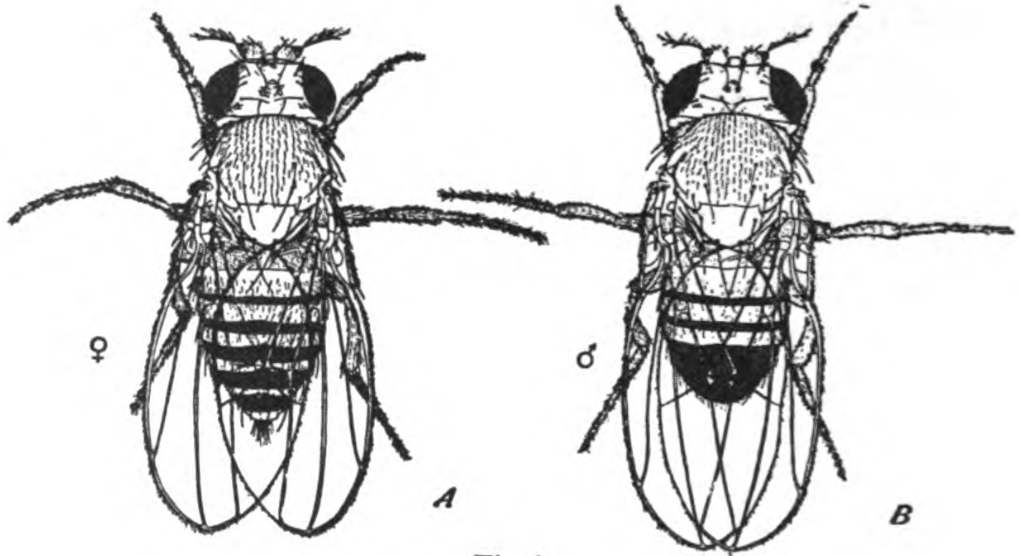

Fig 1

Fig 2

Fig 3

Figure 1. Normal ("wild type") female (A) and male (B) *Drosophila melanogaster*. From: Morgan, Bridges and Sturtevant, 1925.

Figure 2. A mutant affecting wing morphology in *D. melanogaster*.

Figure 3. A *D. melanogaster* gynandromorph, female on the left side, male on the right. This fly started life as a female with one of her X chromosomes carrying a white eye mutation. Only this chromosome is present in the male parts and the fly has a white eye on this side. From: Morgan, Bridges and Sturtevant, 1925.

Where the Rainbow Ends*

Timothy Aldworth

The Government's decision on the siting of the Third London Airport at Foulness has been welcomed by many people, even if they have been thoroughly bemused by the way that decision was made. Some say that conservationists won the day, some say they lost. The *truth* depends on whether "conservation" conjures up images of pretty villages set in a traditional countryside or flocks of seabirds, rare geese and wildfowl on a desolate seashore. Some say that money and publicity finally diverted the airport from Cublington, others whisper wickedly that it would have served Cublington right if the Government had acquiesced in the Roskill Commission's majority recommendation. The question here is whether the ends justify the means. Is window smashing, paint daubing and personal animosity a better way to influence planning decisions than the same energy devoted to painstaking research and reasoned argument? I like to think not, despite the essential and satisfying simplicity of physical protest, because planning is one of the few fields which have developed extensive means of public participation on a rational level.

By the beginning of the Roskill Commission's final hearing, it was clear to anyone straining to hear the political noises off that it was unlikely that any site other than Foulness would be endorsed by a majority vote in the House of Commons. Full-scale public participation in technical debates on planning is justified, if the final choice was made on the basis that, although Mr. Justice Roskill and his colleagues might have tended to accept the economic arguments of the Commission's Research Team, to many participants at the hearing the economic issues were by no means convincingly settled.

The object of participation is presumably to obtain the best plan or specific development decision for the whole community affected, which may be a street, a village, a town or a region. Or, as B. J. Styles puts it (*Journal of the Town Planning Institute*, April 1971, Vol. 57, No. 4):

> "to strike a balance between the need for efficient decision-making and the need to ensure that every viewpoint is taken into account".

* The views expressed by the author in this article are his own and do not necessarily reflect any views held by his employers.

The Skeffington Report (*People and Planning*, 1969) made recommendations on the premise that it is right and proper for members of the public to have a voice in the planning of their environment. Such a philosophy disagrees with our kind of representative democracy and indicates a return to the classical ideal. But why only in planning? Many would like more say in the spheres of education, health and defence, to name only a few areas of wide concern. Why only in the case of planning is the technical officer expected to be directly responsive to public opinion, rather than to public opinion channelled through elected representatives, in considering the needs and preferences of the electorate? Perhaps because the subject-matter is all around us, largely mundane and inescapable. Everybody imagines that he could do a better job than the Chartered Town Planner.

However alluring the Skeffington Committee recommendations may be, they do overlook a considerable body of evidence about who participates and why. For the silent majority to give voice (and who but President Nixon would claim to read its thoughts?), as Skeffington intended it should, presumes basic changes in our society, if not changes in human nature itself.

The present passion for participation could well be reversed, on the grounds of cost and delay, unless it can be demonstrated that better results are obtained with rather than without it. The planning profession is, at present, favourably inclined towards the idea. But if whilst balanced on a public platform, with the chasm of "vague, airy-fairy notions" in front and the pit of "prior commitment" behind, it just receives abuse, its members might be excused if they retreat to the alehouse.

There seems to be a link missing from all discussions of *participation*, and it might be the need to distinguish between participation on a political level and participation in planning at a technical level. The placard waving demonstrator, dashing off angry letters to editors, is participating in a political way by trying to influence a decision to be taken by local or national elected representatives. However, as Mr. Justice Roskill pointed out to those who invited him to frame his own recommendation on the basis of the popular view, even politicians have their own idea of the common good, or hanging wouldn't have been abolished when majority opinion in the country supported its retention.

Participation at a technical level does need different tactics. Here, the participant is trying to influence a technical recommendation –

not a decision – so perhaps I should put forward a view of what this kind of participation should mean for the participator, not so much as a blueprint for victory in some special case which is dear to his heart, but for the future of participation in general.

Today, planning is incorporated into numerous school projects, often with the active co-operation of local planners. Let us hope, then, that future generations of participators will be better equipped than mine to do a good job – that is, they will be better informed about the basic principles of planning before becoming emotionally involved as taxpayers, property owners, parents or commuters.

The intending participator should begin by setting out his objectives: what sort of place does he want to live in, what changes, at least those controlled by planning legislation, does he hope to promote or prevent which will help achieve those objectives? Chosen objectives should be divided into short and long term, so that specific actions can be measured for their fit or prejudice to those objectives. It may be that some of the objectives will be incompatible with others, i.e., free use of motor cars may be incompatible with the preservation of a narrow street lined with historic buildings, so it is also important to rank the objectives in order. Objectives represent value judgements and choices which are personal and not necessarily universal.

After objectives, priorities. There is a pressing need for participators, particularly amenity societies – on both national and local fronts – to decide on their priorities. This is a fundamental part of good management. We should all realize that we live in a small, heavily populated country and that change is occurring at a tremendous rate. This change can be channelled, for good or ill, by planners and participators, but it can hardly be prevented from happening at all. Our rising standards of living put pressures on the available land. We are no longer prepared to live in back-to-back houses at 64 to the acre, to limit ourselves to one bath a year, or to walk to work. Often what we do in our towns requires developments which we would rather not see in the countryside, such as pylons, reservoirs and motorways.

Priorities must be chosen and worked for. Like land, money and time are in short supply. The items at the top of one's list ought to command a lifetime's dedication whilst those at the bottom might be worth only one letter to the local Planning Officer, Councillor or newspaper. Where alternative proposals are up for discussion, even if they are all disliked, participators ought to know which one they dislike least, and why. This requires an examination of primary objectives and a consistent approach, and may ultimately save embarrassment if compromise solutions are negotiated. Consider this example: if a reduction in city centre traffic is desired on environmental grounds *and* people insist on using their motor cars, then alternative routes, perhaps through residential areas, or new roads might be found to be necessary. It is certainly reasonable to question which alternative should be adopted, but to want the town centre improvement and then object to every conceivable alternative for traffic is pointless.

Once the participator has understood the principles involved and worked out the priorities of his objectives, he can begin to collect relevant information. Facts are more telling in the long run than emotional harangues; the latter may be a livelier news story but the former look very much better in an Inspector's Report after a public inquiry. The Department of the Environment's Inspectors try to be especially helpful to amateurs who appear before them, but they must be presented with something concrete to write up. Gross overstatement and distortion are less helpful to further a cause than a straightforward, logical statement of facts.

Even if a local authority is not very forthcoming with information (and many aren't), there is an enormous amount of material in libraries – the planning and architectural journals, local histories and directories, annual reports of official bodies, HMSO publications and so on. It is hard work, but seek and you shall find.

To be effective a participant in the planning process should be constructive, not like the girl who always said "no" on principle and got left on the shelf. Not only is the making of constructive (i.e. realistic) suggestions a good ploy in itself, but it helps to develop an understanding of the difficulties to be faced in planning. Thus, if an historic building needs saving, it is a good idea to know what repairs will be needed and what they might cost, what the buildings could or should be used for and whether that use would be economic. If it cannot be made to pay sufficiently well for private money to be attracted, what case is there for the use of scarce public funds?

If a more rural amenity is in danger the difficulties are greater, as those of us who tried to compare the landscape qualities of the four short-listed Third London Airport sites know only too well. Work is currently going on in a number of planning authority offices to try and establish acceptable methods of comparison of scenic values, so that the power station, dam, road, caravan site or copper mine can be assessed as to whether it does more or less damage, at this or that cost, at one site rather than another.

There is nothing reprehensible in representing a special, minority viewpoint. Indeed it may provide new facts for the planner to digest. Naturally enough, a planner's thoughts are coloured by his upbringing, social background, professional training and political ties but he does have a commitment to the whole community: the rich and the poor; the pedestrian and the motorist; the country and the town. This is not to argue that the planner must be right, but simply that the participator should question his own motives and his mandate to speak for others, as closely as he questions the antecedents of planners.

When citizens are prepared to participate as vigorously in preparing a continuous and total strategy in advance as they do when taking up causes too late, then the enmity, the frustrations and wasted efforts by both planners and the public will be transmuted into a purposeful and beautiful friendship. We shall still debate our objectives and how to attain them, but we shall do so with better grace.

STROPHES*

Pity us, moon men.
You there have us here to guide you,
Boosters, ground control, mutual messages,
Words annulling space,
Automatic homing devices,
Even if you die you will know where you meant to climb to
And where return, you can always pinpoint
Though distant, a home base.

We down below,
We on this ancient joyride
Rocketed or wrecked time knows when since,
Provisions now in shortfall,
Receivers recently gone silent,
At daggers drawn between clueless captains,
Circle in our self-enclosed pursuit of non-goals
To an end certainly mortal.

Clare Campbell

* There is an identical number of syllables in each verse.

Reviews

More Treason from the Clerks

Paul Goodman. *Compulsory Miseducation* and *The Community of Scholars*. Vintage Books, New York. 1964. $1.95.

Jerry Rubin. *Do it*. Ballantine Books, New York. 1970. $1.25.

Philip Berrigan. *Prison Journals of a Priest Revolutionary*. Holt, Rinehart & Winston, New York. 1970.

We are all under the ancient Chinese curse of living in interesting times. At the moment we are being treated to the spectacle of the world's superpower humbled and humiliated by one of its smallest and weakest powers. America's submission is producing some interesting side effects such as transferring American violence back to its traditional objects, Americans, as the troops kill less Vietcong and resort to fragging their own officers and noncoms (fragging is rolling a live handgrenade under the tent-flap of a superior who has reprimanded or otherwise annoyed a soldier).

Violence is as American as apple pie, as Rap Brown used to remind us when he was around, and, in any review of books by American dissenters, the Vietnam war is the right place to start, for its progress, if that is the right word, has exposed a contradiction between American ideals and practice as nothing else in their history has done.

H. L. Mencken wrote that there were second-rate men everywhere but only in America were they always and without fail put in charge of things. Second rateness and venality are not to be confused with fascism of course. It is naif to call America and its leaders fascist and wicked, as many of its children do, while, say, Miss Devlin can tour the States for $2,000 a night advocating the overthrow of capitalism, although Jerry Rubin was forbidden by the Home Secretary to do the same thing in Britain.

Things seem to have settled down again after a shift of alliances in the world of American dissent. Dr. Timothy Leary, the drug prophet, announced that psychedelia was over and the Black Panthers was where it was at. The Panthers leaders then disowned Leary and got him deported from Algeria, all of which seems a bit unhistorically puritan if one considers that "hashisheen" is the original form of "assassin". The Weathermen too have declared solidarity with the Panthers but have not thrown any more bombs of late.

The Berrigan brothers have lectured the Weathermen on violence, and have been credited by *Time* with the fact that all is apparently quiet. It's not easy to see who was still on the field just before the interval, perhaps only the Panthers.

Why has the volume been turned down? Has a point been made or is it only that jobs are now harder to get? Perhaps the calm is deceptive, and the Panthers are only regrouping, making up their enormous losses by jail, exile and police murder (yes, coldblooded murder). Perhaps the Berrigans' forthcoming trial will rank with the great conspiracy trials, with Dr. Spock and Rubin and the Chicago Seven, and will liven things up a bit.

During the interval is a good time to examine some of the literature of American protest. These three books form a spectrum of dissent, but with one obvious shade missing, black; and, more particularly, the prison journal of the Black Panther leader, Eldridge Cleaver's *Soul on Ice*. That book was read by Berrigan while in prison, and after his escape Cleaver wrote the preface to Rubin's *Do It* from Algiers. As I said, most radical groups and persons in the United States now have to define their position with respect to that of the Black Panthers.

But there is good reason for taking these three authors by themselves, for an important fact about them is that they are not underprivileged, black, or even particularly young. On the contrary, they are all in their various ways highly privileged and talented and could be doing much better on the Establishment side. They are *clerks*, in either the traditional or Julien Benda's sense; and their defection, their refusal to betray what they know to be right, is of tremendous importance. These three very different clerks are not dangerous or mad, even though one is a convicted conspirator, one an accused, and one a conspirator in spirit at least. They do not kill: water pistols and blood are their only weapons. They are intelligent, rational, and above all angry, like an increasing proportion of the American young. It is perhaps the intensity of this anger that the non-American finds so hard to understand. What right have privileged, rich whites in America to be angry about anything, he wonders.

If you want to see why they are so angry about education, read Goodman's books at least: if you want to know why they're angry about what their country is doing in Vietnam, imagine yourself a Martian arriving on earth to find that the World's superpower had supervised the killing of a million or two of the population of one of its weakest nations – would you even ask or care to hear what excuses or reasons they gave for doing it? If "policeman" to you means a friendly bobby who sees children across the street, and you wonder why America's young are so angry about their police, consider the following: a Los Angeles policeman last year, for no apparent reason, discharged into a crowded bar a 9 in. high-velocity tear gas projectile designed for breaking through thick walls before exploding. Miraculously only one man, a Mexican-American journalist, was killed. It was only because of the man's occupation that such an everyday incident came to public notice in the Press. The policeman admitted before a Grand Jury that he had no idea what form of ammunition was in his gun when he fired it! The Grand Jury found that there was *no negligence of any kind on the part of the policeman.*

And now to our muttons. In the space available it is possible only to point out to those who already know Paul Goodman that this is one of his best books. Like everything he writes, it is stodgy in parts. All the old ingredients are there: the athleticism, the Gestalt therapy, the anarchism, the arguments for decentralization and the appeal to old Republican values. But at his best he is just so much better than anyone else now writing on the wretched state of American education, most of whose works can be summarised as, "these guys got x billion dollars out of the Government for, say, their Computer Aided Instruction Project and look it didn't produce the results they thought it would, tee hee." Otherwise, and from a platform perhaps an inch higher, there are still the preachers of "national goals in education", one of whom, Dr. Conant, comes in for heavy drubbing in this book. It is this breed of men which has unwittingly brought on the campus revolution of the last few years. To them education is a factory process, quite literally. They write of plant utility and live in a world of grades, scores, punched cards, courses, and the standard predigested course books designed specifically for six hours weekly of Bosh 306B. Everything they touch turns to dross.

Goodman's book was written before Yippie and the recent university unrest. Its historical interest is that it not only predicted and prayed for what would happen, but showed you exactly why. The book has far more than prescience, for what distinguishes Goodman from all the others is that he alone seems to write from a belief in real values; not the values that get an outing in Mr. Nixon's TV speeches, but oldies and goodies like literacy and Western humanism.

The book is really two books; the second and more important, "The Community of Scholars", begins with a long description of the Medieval University, and, at just about the point when the reader wonders why all this one man Gothic Revival, Goodman swings into a contrasting description of the American University of today: the venal robber barons who run them, as they do every aspect of American life; the timidity of men who teach in them, but who no longer believe that academic subjects have any real life or value; the students who *demand* Bosh 306B and suffer through it because they have never been told that there are real subjects of education to know about, and that they themselves are part of a humane tradition that still has more life in it than Zen Buddhism, or How To Live In a Commune.

To people in Britain the book is a warning tract: never let the university administrators get all the prestige while the professors get none; don't abolish technical colleges and encourage everyone to go to a university for which they are totally unsuited: don't construct factory universities so students and teachers cannot get to meet or talk to each other. In other words, hang on like grim death to most of the things that make our system different from theirs.

There are many little insights and sums that help one through one of the grimmest subjects on earth. Goodman shows how amazing it is that it takes four times as much to run Columbia as the cost of the teachers' salaries and the rent put together, which is because the USA has ten times as many university administrators per hundred students as, say, Israel's universities. The walls have come down from around the Medieval University and the administrators have swarmed in to eat up three-quarters of the budget. The only argument *for* them is that they can talk to the National Administrators outside!

This line of criticism comes from Goodman's belief in Gestalt Therapy: that things in nature do not need help to run. The body for example does not need medicines to run normally as an increasing number of people believe. Similarly, education does not have to be administered. All you need is scholars, pupils and a room. As he points out in the first half book on "miseducation" at younger ages, what is so amazing about the American system is that, given all the money, research, attention, and so on, such a high proportion of American children do *not* learn to read. That is what needs explanation.

Like all Goodman's books, there are simple proposals and solutions, but these are less startling than usual because they amount to the setting up of small institutions that bear a remarkable resemblance to the Oxbridge College as it existed at its best. Another interest of the book is his suggestion for a new academic secession: that a group of scholars and their pupils should set up a small rival institution in the shadow of some existing university. This has been tried in a number of places in the USA, and most have already ended, and ended badly. At Stanford the Free University was taken over and destroyed by the militant left-wing students, and all the volunteer teachers driven out.

There are troubles with the book. Goodman is too rough with the better aspects of one of his chief villians, Government contractual research. He has not seen the ways in which the Washington sponsors do act like independent medieval princes, of whom he would surely approve, supporting the scholars they like for no practical purpose other than to further good work. He tells us at length that modern academics do not constitute a community of scholars in the old and best sense, and that in earlier periods of university fossilisation the thinkers of the age, Descartes, Hume, Leibniz, Bacon, Spinoza, Berkeley, Locke, et al, were to be found quite outside the academic world. One advantage of Government research that Goodman does not seem to see is that it can provide the means that personal moneys did for those great men, and can set academics free of both want and of participation in the academic community in its present awful state.

Goodman is an idol of the modern American young, but unlike them he has a sense of the past going back before 1941, or even 1776. He loves but chastises the young, though unlike many of his generation he does not want to take any revenge on them. He is not entranced and fascinated to see them taking on the semi-articulate speech of deprived groups like the blacks. Rather, he is angry with those who imprison them in school for sixteen years but teach them nothing in that time, not even that it is not the work of a lifetime to learn to write an English sentence. They are held down to the trough for a large chunk of their lives but are fed nothing. They might as well have been playing in the streets. Why, he asks, be forced to work sixteen years to get a simple diploma, essential for a semi-skilled job, when you could pick up all that was needed on the job in a few weeks?

I once stood behind a group of intelligent American college students in an art gallery in a large city. They were looking at a painting of an old man who had tied his son to a rough altar and was lifting a knife to kill him. There seemed to be a ram in the middle distance. They could not find the title in the catalogue and were asking each other what it was all about. That made me see what Goodman is angry about, and why millions of Jerry Rubins think that the whole educational system, and the culture that produced it, can be dismissed without discussion.

If you want to see just how angry the American young are, Rubin's book is more fun to read than most while getting the message. Paul Goodman has been a cool rational anarchist theorist for several decades, but even he has been unpleasantly surprised at the old-fashioned manifestations of anarchism that have blossomed in the last year or so. Not only the Weathermen's bombs, but even the old black flag has been run up here and there. The one persistent element in anarchism that forgives it a lot is its sense of humour. In his latest record Neill Young sings, "don't let it bring you down, it's only castles burning", and one thinks of Prince Kropotkin, The Anarchist Himself, descending from his travelling coach in the middle of the Steppe on seeing some peasants setting fire rather inefficiently to a castle. When he leaves, the building is burning well on all four sides. *Noblesse oblige.*

Rubin's escapades are in the Great Tradition: he organized "Death of Money Day" in New York which produced the spectacle of millionaire brokers at the Stock Exchange scrabbling and fighting for dollar bills scattered from the public gallery by the Yippies. Even those who didn't enjoy his water pistol attack on David Frost on British TV had to agree that the Golden Boy from the Manse had it coming to him.

Now in this book we get the prologue to Death of Money Day. Rubin and his companions were stopped on their way in to the Exchange by an Attendant who said they couldn't enter because they were Hippies:

" 'Hippies', Abbie shouts, outraged at the very suggestion. 'We're Jews and we've come to see the Stock Market.'

Attendant's vision: The next day's headlines.
NEW YORK STOCK MARKET BARS JEWS."

They got in.

It's important even now to be clear about the genesis of Yippie – the Youth International Party. The Press will not get it straight and use the word interchangeably with "hippie". As our author says,

"A dying culture destroys everything it touches. Language is one of the first things to go. . . . How can I say 'I love you' after hearing

'CARS LOVE SHELL.' "

He then defines Yippie:

"To be a yippie you got to watch colour television at least two hours a day, especially the news."

"The hippies see us as politicos and the politicos see us as hippies. Only the right wing see us for what we actually are."

The Rubinesque is a style, and an essential element in it is disarming all criticisms by embracing them cheerfully:

"Give us an inch – we'll take a mile.

Satisfy our demands and we got twelve more.... All we want from those meetings are demands that the Establishment can never satisfy. Satisfy our demands and we lose."

"Everything the yippies do is aimed at 3 to 7 year olds. We're child molesters."

It doesn't need a Freudian to spot the desire and need for opposition: for the stern unbending parent who was never there in childhood. Rubin is quite frank about his aim of prolonging adolescence beyond all previous bounds.

"No longhair ever asks another longhair his age – it's a counter-revolutionary question."

He doesn't want a *real* revolution to succeed. He knows perfectly well that "if the white revolutionary left took power . . . the hippie streets would first be cleaned up by "socialist" pigs (police). We'd be forced to get haircuts and shaves every week. We'd have to bathe every night and we'd go to jail for saying dirty words.... We'd have to attend compulsory political education classes at least five nights a week. Rock dancing would be taboo, and miniskirts, Hollywood movies and comic books illegal."

As he says, the revolution is *now*, and the fun is being together in it. You just meet a nicer kind of person that way. The yippies are marxist, he tells us, "firmly in the tradition of Chico, Harpo, Groucho and Karl." It is amazing how people can misunderstand the book on this point. In his nasty and angry little review of this book, Mr. Richard Crossman (*New Statesman*, 20th November, 1970) calls it a "Mein mini Kampf" and tells us that the book reminds him of the "Cunning perceptiveness of the vulgarest Gauleiters".

But that is silly and way off the mark. Mr. Crossman remembers the thirties so vividly that, like many people, every political trend he disapproves of leads straight to the gas chambers. The only similarities are the emphasis on spontaneity, and a dislike of communism and much of monopoly capitalism, but that isn't enough to make one a fascist. Jerry Rubin is too Jewish and talks too much about freedom for that. Mr. Crossman has simply got his traditions mixed up: Yippie is classic anarchism.

Another instructive error of Mr. Crossman's is saying that *Do It* is another manifestation of that old favourite, white middle class guilt about the blacks and the workers. Wrong again, for if there's one thing this book isn't, it's guilty.

"The Yippies see white middle class youth as a revolutionary class. We are exploited and oppressed and we are fighting for *our freedom*. We do not feel guilty because we're not black, Chinese or factory workers."

What is this exploitation? Insofar as the target is specific it's the Universities again, the venality of the Regents and the cops on the Campus. In Goodman's language, it's about the campus having no walls any more and the teachers having nothing to teach.

"Professors are afraid to go to parties with students," says Rubin, "because they may be handed a joint. And joints are illegal. The logic of fear. People who fear have nothing to teach us."

The main set piece of description in the book is the police siege of the University of California at Berkeley.

"You had to feel some sympathy for the President of the University, Clark Kerr. He was so proud of his statistics and blue prints. The millions he panhandled from the Federal Government and from big businessmen. The number of Nobel Prizewinners at his university. The scores of buildings he built. Weapons discovered. New departments. The football team. But whenever Kerr travelled the country, nobody asked him about his Nobel Prize winners or expansion programmes, 'What about those student demonstrators on campus?' they asked over and over again. Poor Kerr. We stole his university right out from under his nose."

Until someone can explain to me in clear rational terms why the university administrators, there and almost everywhere else in the United States, reacted the way they did to student sit-ins, I can only see Rubin's point of view. Why the mindless activism? Why, if students sit down, must hundreds of armed men with shotguns be brought in to maim, beat and kill; and kill they did, don't forget. Why must everything be handed over to men of the stamp of the Sheriff of Alameda County, adjacent to Berkeley, who, when asked why it was necessary to discharge large-bore shotguns into helpless crowds, replied "That's the way the ball game has to go." Why not just leave the students sitting there, as most British Universities have done?

Jerry Rubin would heartily agree with Crossman when he calls him a showman-seditionist. Much of the book is given over to the theory of demonstrations as theatrical productions. "Always include a part for the cops," we are told, "they come perfectly dressed for the rôle of bad guys." One of the central scenes in the book is Rubin's appearance before the House Un-American Activities Committee dressed in the Revolutionary Uniform of 1776. With it come reminders on how to get HUAC to pay your airfare to testify, and then to buy a youth fare with the money and live off the remainder for two months!

Rubin is, as he says, a true child of America; he understands as one born to it how to get the attention of TV and the Press. The last thing he wants is any kind of revolution that would do away with the communications system that has made him a world-wide folk hero. He understands the emptiness of political argument today and that what people want is a new myth that can, if necessary, be totally information free:

"The myth makes the revolution. Marx is a myth. Mao is a myth. Dylan is a myth. The Black Panthers are a myth. People try to fulfil the myth: it brings out the best in them. The secret of the Yippie myth is that it's nonsense."

All this quotation is unfair and misleading, but in the end there is little left but the style, though there are many good perceptive remarks on the way: "Martin Luther King was only as powerful as the black man standing behind him with a molotov cocktail. If you don't talk to me you're going to have to deal with some mighty mean niggers!"

My thought on picking up the Berrigan book was that here is a just and sincere man, more admirable and in an older tradition than Jerry Rubin, but who would undoubtedly be boring to read. Fr. Camilo Torres died with a sten gun in his hand in South America, but I thought that Berrigan's only claim to attention was that he was a turbulent priest in the United States, of all places. But I was quite wrong, even though he is incurably cheerful and brave, his statistics are a bit off, and the book is badly edited, sometimes from tape recorded interviews, which leads to repetition.

Nevertheless, the book is of some interest, and gives a clear picture of a man apparently guided by nothing but Christian duty and love. I am a bit dubious when told by Che Guevera that a revolutionary is moved by feelings of pure love, but in the case of Philip Berrigan I can almost believe it.

He and his brother priest Daniel came to public attention when they poured blood over draft files as a protest against the Vietnam war. While awaiting sentence he poured napalm on to more draft files and was sentenced to six years in jail. More recently the two brothers refused to surrender, and were hunted by the police for months while being hidden successively in the homes of hundreds of loyal families. Since capture they, along with a nun and other catholics, have been charged with conspiracy to bomb and to kidnap Henry Kissinger, President Nixon's adviser on national security.

Anyone who saw it will remember the photograph of the grinning brothers, chained after their recent capture. They looked more free than their dour captors, even though fastened with handcuffs, waist and ankle chains. Americans have an obsession with chains and shackles. A frequent and remarkable sight there is that of a motorist stopped at random by the police and then led away in *handcuffs* after they have found out over the radio that at some point in his life he failed to pay a $2 parking fine.

So there is to be another grand conspiracy trial soon, and it will be in the best tradition of the trials of recent years if the account of Berrigan's earlier trial, given in this book, is anything to go by. Berrigan's character is utterly different from Rubin's, but he too is a showman-seditionist. At one trial he got the whole court, judges, prosecutors and all, to rise and recite the Lord's Prayer.

Inevitably, much of the interest of this book has been as a source of indirect evidence as to whether Berrigan, who said that no cause was worth one life, could now have changed his opinions so far as to have conspired in the way that the Federal Government claims. No quotations from the book will settle the matter. He says clearly that legal dissent is inadequate to the enormity of the daily crimes committed by his Government in his name, but the burden of the argument seems against violence, at least on his own part:

"The Christian is neither for nor against the violent revolution; he transcends such a choice by his dedication to a more basic change, the spiritual revolution commanded by Christ. On a given occasion he may tolerate and approve – but not actually join – a violent revolution, having judged that political and social injustice had reached insufferable limits."

But the book is what it claims to be: a jail diary, written in secret because the authorities had forbidden him to write anything political.

It has the interest of any such account written by an intelligent and sensitive man about a place few of us are ever likely to see, and most of whose inhabitants are illiterate and black and unable to tell us how it is. There is also the added bizarre interest of insight into the nature of American jails where, compared with our own, the physical conditions are luxurious: freedom about when to get up, excellent cafeteria food, and so on, yet where, because of the natures of the guards and inmates, the human conditions are indescribably worse. The rate of the racial murders in American jails, for example, may well equal the murder rate for the whole of Britain, one reason being that blacks are frequently in the majority in American jails and can begin to redress their wrongs on the captive white minority. Berrigan himself, who has identified with the poor and black all his life as a priest, was unwillingly involved in such a situation. He had an overpowering desire to beat up a black in the bunk below who shrieked all night to annoy him.

"I could not bear to speak to him, to take him casually or jokingly, to have the slightest normal thing to do with him. The only communication between us was his readiness to harass me and mine to break him if the occasion offered."

What distinguishes Berrigan from so many radicals is that he never squeals at what happens to him. He even tried to prevent his lawyers from appealing his sentence. His going to jail is the witness of a just man, a proud and lonely figure.

"The casualties of our society fill this jail, as they fill all the areas of the world that are threatened by our investments and arms. For the Christian, perhaps, the best hope lies in becoming another social casualty, but of a different kind."

While inside he organized, helped and worked tirelessly. The feeling one gets is that he must have improved the spirit of everyone around him by his presence. Perhaps all prison chaplains should be inmates.

There is little on doctrine, or wider church topics. Berrigan, as he says himself, is not very interested in the liberalization of the Vatican Council while the whole ship is sinking. The book is in many ways more impressive than Professor Chomsky's anti-war tomes: Berrigan is less bright but wiser. He does not nit-pick the arguments of the US Administration to show them up as liars and hypocrites: that is unnecessary by now. As Jerry Rubin puts it in another idiom, "Many children want to grow up to be Che Guevara – but did you ever meet a child who wanted to grow up to be like Richard M.

Nixon?"

In the end Berrigan will probably do more for the Peace Movement in America than our other two authors. Goodman speaks to the tiny minority who are open to the arguments of humanity and reason. Rubin rallies the faithful and cheers them up a great deal, but could perhaps be written off, as someone did the hippies in England, as "as powerful a threat to the power structure as people who put foreign coins in their gas meters". Berrigan, however, not only acts theatrically, but is the Establishment's sort of man: a pillar of moderate mindedness and respectability in a world of drugs and sex. No draft dodger, he is a decorated war hero. He is as big a catch as Telford Taylor, the Chief American Prosecutor at Nuremberg, who a few months ago said that the charges he brought against the German leaders could probably be laid against the American High Command.

As I said at the beginning, the war has been the carrier wave for all other forms of protest. This has been true even for the blacks, who have argued that the war is squandering money better spent on them. It is true also for those whose main targets are the Universities, since the war has shown the administrators to be as heavily involved, whether through research or investments, as the other corporations. Mr. Nixon knows this as well as anyone, and that is surely one reason why he would dearly love to end the war as soon as possible, and by any means indeed, short of the obvious one of just stopping and going away from Indo-China. What will happen to the structure of protest after that is anyone's guess. Jerry says, "When the war's over we'll find another one." We shall see.

Yorick Wilks.

John Lennon's Music

John Lennon/Plastic Ono Band Apple PCS7124

These are remarkable songs. Much in the style and substance recalls some of Lennon's later Beatle music, but this record is unique. It is spare and stripped away. The words are short, the poems without images. The arrangements are simple, the production devices discreet. This is John Lennon's own music. It is entirely personal. The songs are of feelings, experienced and expressed with an intensity and an openness that command attention.

Some people find this disagreeable, perhaps more so because of the pain evident in the songs. The winning sound of the Beatles is long gone. The opening track, *Mother*, is a touchstone. It is a parting from the mother and the father Lennon never had. The words tell it directly. At the end Lennon cries again and again

"Mama don't go
Daddy come home"

over repeating piano notes and a rhythm that pushes into the bodily feelings of the cries. The loss is desolating but the song is not desolate. Lennon's great pain is clear in the tag at the end of the record,
My Mummy's Dead.

". . . So much pain
I could never show it
My mummy's dead"

Here a child's intolerable suffering, sounding in nursery rhyme echoes, is distanced by a set of devices; the voice coming through a megaphone over a sequence of chords which begins before the bar and ends unresolved, rolling out in an almost mechanical way that suggests a half wound music box, the whole made to sound like an ancient shellac record, something found in the attic of memory, coming out with its inevitable buried message as clear as the time, years ago, when it was lost. It is strange, affecting. Listening to the record we are witnesses of suffering. But in the freedom of expression, and through Lennon's artistic command, it has become a suffering that can no longer oppress. Much turns on this. Just so, in *I Found Out*, the printed words urge

"Can't do you no harm to feel your own pain"

The phrase could serve as an epigraph to the practice of Arthur Janov, the Los Angeles psychotherapist with whom Lennon spent four months just before making this record. Janov's therapy is of a very active kind not known outside America. The affinities between his ideas and the lyrics are evident, but I don't wish to pursue them, firstly because Janov's therapy is experiential and the experiences are unfamiliar, and secondly because Lennon is the artist who made the music. But it seems worth identifying the connection between Lennon's experiences with Janov and this record because the sense of explicit self-realization in the songs is far beyond the ordinary. *Mother*, where the feelings are most basic, shows this special tone clearly. In different ways it pervades the record. It shows in the beautifully open eyed way Lennon picks off preoccupations that veil the human. The last long song, *God*, is a turning point. From

"I don't believe in magic
I don't believe in I-Ching
I don't believe in Bible. . . ."

Lennon numbers off a litany of rejection till he reaches

"I don't believe in Beatles"

The song hangs for a moment in silence. The resolution is a modest affirmation that is for that a profound, true, triumph. The song, and the record, becomes a celebration of rebirth from dreams, and overall its feeling is not of pain, but of a certain lightness and hope. The loveliest song, *Hold On*, carries this hope on its easy, bright, riding sound, half eastern, half country. The scale is small, the hope is for now. That's all – but that's enough.

Lennon has transmuted experience into art, without self-indulgence. In large part it is our response to his experience, that is, to him, that draws us to the songs. If there is anything missing, it is in this dimension. There is an absence of any sense of others, apart from his wife, as capable, however intermittently, of some meaningful loving response. *Love*, pretty as it is, seems less real than the other songs, skating on the edge of sentimentality. The lyric loses the thread and never stands away from Phil Spector's delicate saccharine piano. The real feeling is the feeling of *Isolation*, in which Lennon's voice, double tracked, shouts in our ears

"I don't expect you to understand
After you caused so much pain
But then again you're not to blame
You're just a human, a victim of the insane"

Set against the personal emancipation of the rest of the record, there is a sad paradox in this. The songs don't discover a way out of this circle. The man who sings

"I heard something 'bout my ma and my pa
They didn't want me so they made me a star",

and who was more popular than Jesus, is the leader . . . "trying to change the whole wide world" whose leadership is vitiated right here.

There is much else in this record. John Lennon recently described himself as a genius. He is, and something more. Listen to this.

Roger Freedman

Sentences

How shall I sing that Majesty
Which Angels do admire?
Let dust in dust and silence lie;
Sing, sing, ye heavenly choir.
Thousands of thousands stand around
Thy throne, O God most high;
Ten thousand times ten thousand sound
Thy praise; but who am I?

Thy brightness unto them appears,
Whilst I thy footsteps trace;
A sound of God comes to my ears,
But they behold thy face.
They sing because thou art their Sun;
Lord, send a beam on me;
For where heaven is but once begun
There Alleluyas be.

Enlighten with faith's light my heart,
Inflame it with love's fire;
Then shall I sing and bear a part
With that celestial choir.
I shall, I fear, be dark and cold,
With all my fire and light;
Yet when thou dost accept their gold,
Lord, treasure up my mite.

How great a being, Lord, is thine,
Which doth all beings keep!
Thy knowledge is the only line
To sound so vast a deep.
Thou art a sea without a shore,
A sun without a sphere;
Thy time is now and evermore,
Thy place is everywhere.

John Mason, c. 1645-94

The late Victor Ranford was a member of the Society of the Sacred Mission, Kelham. He studied Philosophy in the University of London, and spent a number of years in South Africa.

Margaret Masterman studied French Language and Literature at the University of Paris and Modern Languages and Moral Science at Cambridge. She is Director of the Cambridge Language Research Unit, a Director of Studies in Moral Science, and has been a lecturer in the Moral Science Faculty on philosophy of language. She is Vice-President of Lucy Cavendish College, Cambridge.

Frederick Parker-Rhodes was at Magdalene College, Cambridge and is now a research worker in Computational Linguistics at the Cambridge Language Research Unit.

Ted Bastin is a Theoretical Physicist and Information Scientist. He works at the Cambridge Language Research Unit and at Stanford University, and was formerly a research fellow and Isaac Newton student at King's College, Cambridge.

Roger Woolger (who translated Simone Weil's paper) read Philosophy and Psychology at Oxford, and after spending some time in Ghana as a British Council Officer, went to King's College, London, to do research in the philosophy of religion, writing a short dissertation on Simone Weil. He is now training as a psychotherapist in Zurich.

W. Grey Walter read physiology in Cambridge. His main work has been in Neurophysiology and Electroenchephaly, and he is Director of Research at the Burden Neurological Institute in Bristol. He is author of "The Living Brain" and a number of papers on neurophysiology, electronics and cybernetics.

Michael Ashburner read Natural Science at Cambridge, and is a University demonstrator in the Department of Genetics. His main research interest is in developmental biology.

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Clare Campbell has been a journalist, civil servant and teacher. She now supervises in English for several of the Cambridge men's colleges. She published a volume of poems in 1953, and is particularly interested in the areas of discipline which poetry and music have in common.

Gillian Garnett, who designed the cover, was at the Bath Academy of Art and now teaches at the Cottenham Village College, Cambridgeshire.

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Editorial

We have a discussion of old age in this number, in which Peter Avery talks to two doctors both of whom are mainly concerned with old people who are going to pieces in various ways. This affects their view, as they acknowledge. They see the sheer scale of physical care needed, and they lower their sights for what might be the norm of old age, not only for the physically and intellectually exceptional. They indeed want to see "social roles" in which old people can be less unhappy and even go on being useful, and they want this need to be recognized by having more flexible retirement policies. But they do not rise to suggestions that, besides these palliative ways of making old age more tolerable, there may be excellence for which old age is the time *par excellence*. Shrewd and humorous comment born of long experience is always valued in the old. But what about the mysterious clarity and force to which the term "sanctity" has traditionally been applied? This is much more than benevolence; it may be too hot to handle with comfort, indeed. (Julia de Beausobre, who we have asked to comment on the discussion, has more to say on this.)

This discussion has evoked an extremely violent reaction from some younger members of the editorial group who have read it. They say that the doctors "by their own admission are declaring themselves to be therapeutically incompetent". Suggestions made include, "Should not the nurses be paid big salaries in geriatric wards rather than doctors?" "No male should be allowed to direct a geriatric hospital", and "Could not the patients be given a chance to euthanase the most purblind doctor (by vote) with the knowledge that the next purblind would be euthanased at the same time next year?" They go on to say that the doctors are failing to allow for the possibility that in the right kind of society, and indeed in some traditional ones, supreme excellence only comes out in old age (as the ancient Chinese sages said, "Life begins at 70", and they were not only referring to the fact that people gave you esteem). And what, they say, will contemporary geriatric research look like in 100 years, should it turn out to be the case that what it takes to be the geriatric norm has about the same relation to "real" old age (as for instance seen by the Yaqui sorcerer in his description of the struggles with the fourth and last enemy of the "man of knowledge"[1])

[1] See *T. to T.* IV iii, p. 96.

as a pile of six-months aborted embryos, not yet quite finished off and still writhing, would have to a crêche full of new-born babies before and after feeding?

This is an extreme reaction; the analogy is such as to make one feel sick, as is no doubt intended; and we older members of the editorial group would not completely endorse the attack on the doctors. We think better than this of what our doctors are already trying to do against the odds of numbers and of inadequate present research. The difference of reaction is not only, nor perhaps primarily, that of the generation gap, about which David Clark speaks so well in connection with his own still younger teenage generation children. It concerns more the emphasis given to the kind of research which might be done. The young are not only prepared to say that they *know* there is more to the human body plus mind than present geriatric science allows for, but also are pressing further the concern that these questions, including that of a future life, should not just be matters of religious faith, but could and should be matters of scientific research. Where we all agree (editorially) is in saying that the kind of old person at present exceptional in our society should be studied as the norm, both in the sense of "norm" where it means the standard to be aimed at, and in the sense of what is the "normal" thing to look to and prepare for. But if in fact what we have got is a non-existent spirituality, a truncated biology, a totally jejune sociology, and a fairly advanced technical apparatus, what our geriatric specialists will become is medical technicians. How much biological and psychological study has been made of how vitality is maintained in the people who go on doing adventurous and creative things in their 70's and even 80's? (Winifred Coate, whose co-operative village settlement in Jordan we wrote about in *T. to T.* II ii, is such a person in her 70's.) What are the conditions which help them to be like this, and how did they train themselves to get like it long before they were old? We propose to ask some of these people to write for us about this.

As a start, we have asked Julia de Beausobre, one of our subscribers, to comment on the discussion. She is the author of a book significantly called "The Woman who could not Die", an account of her imprisonment by the Ogpu; she has lost two husbands, one by firing squad, and has an injured back. She is an artist and contemplative, who, at 77, has just published a major work, the biography of her late husband Sir Lewis Namier, and she has been getting excited over the scientific articles in *T. to T.*

* * *

Since our discussion took place there have been public controversies over old age. On the one hand a meeting of biologists has been told that "a 10 to 15 years' extension of active human life by slowing down the basic biological mechanisms of ageing is likely to be achieved within 20 years. The first large-scale human trials of an anti-ageing drug or dietary régime will almost certainly have begun in 1975". Reported in *The Sunday Times*, this evoked the headline "Old Age may soon begin at 90". The announcement produced outcries about what this deferment of old age would do to a labour market already showing redundancies for the middle-aged (in other words, the yardstick is profitable competitive employment). There is still the question of what the centenarians would make of their old age.

However, if the Professor of Bio-Chemistry at Oxford has his way, old age will not begin at 90: he told the British Association at Swansea that medical research should cease to interest itself in people over 70. Old age was a misery to them anyhow, and they had better be left to die off. Here is an example of *callous* humanism. Our two doctors are not callous humanists – far from it. But their humanism does not go far enough to get to grips with this attitude. In earlier *T. to T.s* we have spoken of the need for "an open trans-humanism", and in a review in *The Sunday Times* (12 September) Brigid Brophy says, "We need a vast movement of Human Lib, and we're offered a diversionary though not diverting sideshow" (referring here to Women's Lib).

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How science connects or fails to connect with an imaginative view of human possibilities is a question which also comes up over the controversy at the British Association at Swansea over the "Doomsday Syndrome". This was the title of the Presidential Address by John Maddox, editor of *Nature*, to Section X, "General" (this being presumably the Section where any topic otherwise unclassifiable can blow up). His address called out an "Anti-Presidential Address" from Hilary Rose, a Lecturer in Social Science at the London School of Economics. We have made space to print the press release of this. Part of John Maddox's address appeared in *Nature* 233, 3 September. John Maddox thinks that scientists and policy makers using their results are sane enough for the horrors forecasted by the doomwatchers not to be likely to happen. Also he pointed out that it can be misleading to assume that present statistical trends will necessarily continue into the future. In an address to another section, Sir Robert Cockburn remarked that on this count in a hundred years we should all be spending our lives airborne at 60,000 ft. Of course the biggest current Doomsday horror is the prospect of population growth; but, said John Maddox, there have been periods when populations have stabilized after periods of growth. Moreover, "the rapid growth of the world's population in the past thirty years is almost directly attributable to the way in which better medicine and better insecticides (used against the mosquitoes which carry malaria, for example) have enabled hard-pressed communities to keep their children alive until middle-age. In some quarters, quite misguided, this is held to be a proof that medicine and insecticide technology can be "blamed" for the growth of the world's population. The truth is of course quite different. In present circumstances there is good reason to think that one of the conditions that must be satisfied before rapidly growing populations take the steps to limit the pace of growth which seems to have taken place in the eighteenth century in Britain is that there must be still further improvement of medical care in infancy. In South America, India and South-East Asia, it seems to be quite commonplace that mothers when asked how many children they would like to have provide higher answers when the infant mortality is high. For reasons which are obvious and which cannot be dismissed, they take the view that they must have enough babies to make sure that one at least will grow up to be an adult male. But it is clear that prosperity is another condition to be met, as recent experience of a falling birth rate in places such as Hong Kong and Singapore bears out" (*Nature* 223, p. 16). He also says that, though there are ups and downs in food production, on the whole increase in food producing capacities has more than kept pace with increases in population. And he believes that the greatest Doomsday horror of the 1950's, the threat of nuclear war on a catastrophic scale, is now in retreat.

John Maddox's chief fear is not Doomsday, but the paralysis produced by the literary and popular presentation of "Doomsday" situations. "This serves to unify two forces. The people who aren't particularly fond of science, who believe that scientific and technological growth are ultimately harmful, and what is more harmful, a great tendency among professional scientists to deal with the social consequences of their craft by trying to make sure that there will be no social consequences, by trying to get back to the ivory tower. And I think that these two views – the anti-science view and the ivory tower view – have made an alliance." (As reported in *The Guardian*.)

This needs saying. But neither the President nor the Anti-President seems imaginative enough about how to meet the Doomsday paralysis. Hilary Rose gets in some splendid shots (we wish we had thought of "Monodtheism" to describe the pure scientific detachment of Jaques Monod's recent book). But her main solution is too simple. She wants democratic participation in decisions concerning scientific projects. Can we be sure that "the people" will be all that wise? There can be wars with popular backing (as was Hitler's war). The T.V. series "The Doomwatchers" worked on the general pattern of a sinister group of scientists unscrupulously prepared to produce horrors out of their researches, but being prevented and unmasked by the noble team. It had the characteristics of a thriller where the goodies are engaged with the baddies and just win against the odds. This conspiratorial view fits in with how many people naturally think. In fact scientists mostly are worried about ethics, just as other people are. But they are hamstrung by the same limitation as our doctors: the inadequate views of human beings in the assumptions of most contemporary sociology and psychology, so that there is a split between their ethical promptings and their scientific views. This won't be cured, as Hilary Rose rightly sees, by just invoking the values of the disinterested pursuit of science as if this could produce a complete ethics. But neither will it be cured by encouraging scientists to be paranoic over thinking that the public sees them as conspirators.

What is needed is not direct popular decision making on the applications of science, though of course we need to be able to get information about what is going on and on occasions make a row about it. What is needed all the time is more awareness among scientists and technologists (including here planners) of what it would be like to live with the results they produce, and more openness to suggestions from the wearers who know where the shoe pinches.

Our contribution to this so far in *T. to T.* has been mainly through the series which started off under the rubric "Technology in the Enhancement of Life", where we have invited technologists, and especially engineers, to come up with ideas about things that could be done (or are being done) to enhance the quality of the environment. If Sir Alec Caincross is right in his Presidential Address to the whole British Association, that innovations are unlikely to come from direct Government initiative, then widespread unofficial initiatives are all the more important, and particularly perhaps small science based industries in close touch with their consumers.

Not only in the series "Technology in the Enhancement of Life", but in its general approach, *T. to T.* stands for the union of science and humane imagination. But this will not be kept alive on a superficial view of the nature of human beings, so the technological interest has to go along with the "metaphysical" interest. Will our approach qualify us to be "The Pangloss Journal for Public Reassurance" which Hilary Rose forecasts? (It is true that we are published by Macmillan Journals.) We do not subscribe to the Doomsday gloom, but we also believe in bringing up questions which people sheer off talking about.

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Doomsday Syndrome or Doomsday Reality:

*An Antipresidential Address**

Hilary Rose

In the first part of my talk I am going to discuss whether what John Maddox has titled the Doomsday Syndrome, namely that modern science and technology are about to usher in disaster and holocaust, is an old and familiar syndrome in trendy new guise, or, whether there are elements of a new problem.

Secondly, I shall go on to discuss what I think *has* changed: how Doomsday Syndrome has been transformed into Doomsday Reality, and, how many younger and more radical scientists have begun to question the hitherto unquestionable assumption of the inevitable contribution of science to human progress.

Thirdly I want to illustrate some aspects of Doomsday Reality.

The conclusions that I wish to draw are: that the doomsday element is an integral part of science in the kind of society in which we live; that what has prevented, and continues to prevent scientists from seeing this is a conception of themselves as members of an élite community bound by rules different from those of the larger society. I shall argue that this mystification of scientists and science has been aided and compounded by the dominant model or paradigm of science which professional sociology has so far offered us.

Lastly I will conclude with some proposals for action. While these will be addressed primarily to those who are working for a structural transformation of society, some of the proposals may well deserve consideration by those who are unhappy with, for example, Sir Ernst Chain's conception of social responsibility in science as demanding the scientist's unquestioning loyalty to his nation and to his employer. The tradition of dissent, which in this country, has in its time included many scientists from a Priestley to a Bernal or a Haldane, is presently confronted with its share of a growing and international enthusiasm for "law and order" and repression. The protection of this tradition, which was itself never the product of dull conformity, demands a level of involvement which will have

* Press release of an address to the British Association Meeting in Swansea, September 1971.

to be much more practical and concrete than the utterance, however urbanely, of liberal generalities.

First then, I would argue that the belief that modern science and technology are about to usher in disaster and holocaust, is not a new phenomenon – at least so far as the general public is concerned. There is good evidence in fact to suggest that the seventeenth century which saw the birth of modern science saw also the birth of ambivalence to science bordering at times on straightforward hostility. Thus that first invisible college of scientists, the Royal Society itself, elicited the barbed pen of Dean Swift for its pretensions. Anti-science and science took the stage of the B.A. when Huxley and Bishop Wilberforce battled out the implications of evolutionary theory. More recently in 1927 the Bishop of Ripon preaching the B.A. sermon, and perhaps more surprisingly the president of the B.A., the economist Sir Josiah Stamp, in his presidential address in 1934, argued that society needed time to digest the innovations of science and technology and that therefore there should be a moratorium on research.

But throughout this entire period, so far as I can see, the scientific community itself took a common position. The attitude of anti-science, of doomsday mongering, as the editor of *Nature* would call it, was resisted by all shades of political opinion among scientists. This consensual hostility towards the anti-science camp, which might be interpreted as simple professional self-interest up to the 1930's, becomes a more curious phenomenon during the 1930's. After all, this was a decade marked by the most intense and partisan interest in the relations of science and society, and yet which saw scientists unified against irrationalism and anti-science. Although the Marxists, the pragmatists and the laissez-faire scientists made uncomfortable bedfellows, they retained a positive attitude to science; either it was to play its part in ushering in the dictatorship of the proletariat and the new socialist man, or, at the other extreme science was to be done with no state interference and for its own sake, with the pragmatists sitting pragmatically between. The key to the making of this unlikely alliance was the growing threat of an irrationalist and anti-science ideology. I speak of course of Nazism. It is perhaps worth noting here then when scientists are urged today to unite against the counterculture or the writings of the new left against science, it is sometimes implied that the cause is in some sense parallel. That in the 30's scientists represented oppressed critical thought whose very existence threatened the phoney scientific legitimation of racist theory, whereas today's social critics are frequently hostile to science, is glossed over in general appeal not to rock the scientific boat.

Even those scientists who were concerned with the social implications of science, preached *caution*, *never* like a Goffman and Tamplin or an Ehrlich, doom. The new found Association of Scientific Workers was anxious that scientific workers had so little control over the uses of science, but staunchly believed that scientific work played for the most part a significant role in securing human progress. Even those Cambridge scientists who signed a letter to *Nature* in 1936, urging that the prostitution of science for war purposes should cease, had no doubts about science herself, only her abuse.

Historically, the possibility of unbridled optimism about science stops in 1945 with the development and use of atomic weapons, and a new era begins. This is where I come to my second point, and take issue with John Maddox, for what he calls the Doomsday *Syndrome* really only comes into existence with a Doomsday *Reality*. While, as I have suggested, the ambivalence to science by laymen is as old as science itself, scientists only began being a little disillusioned with science when some of their toys registered the possibility of holocaust. It is possible to argue that the notion of *syndrome* has been chosen to suggest a pathological aberration from the normal healthy body of science. It is, as it were, a mild pestilence, an epidemic, of anti-authoritarian anti-rationalist dreamers or some such, which can be put right by, if not a dose of salts, at least some British pragmatic good sense and first class minds.

Of course we could try telling that to the Vietnamese, that there are a "lot of publicists with Ph.D's. talking about ecocide" (*Nature* quote), and that they are Jeremiahs and it's all part of the Doomsday syndrome. I do not think that they would be entirely or even partially convinced. For many Vietnamese in Quang Ngai province or for Laotians who once lived on the Plain of Jars, where, if they are alive at all, they must now hide underneath it, the Doomsday Syndrome in science is not a fashionable issue in intellectual circles but a very concrete everyday reality.

Because the war in Indo-China has involved the most massive use of science and technology in history, and yet one which, to my knowledge, the B.Ass. unlike its sister organization the A.A.A.S. has not seen necessary to discuss in any extensive way, I would like to document briefly the Doomsday reality. (In parenthesis I believe there was a discussion – albeit an unplanned one – in the war when a defence scientist demonstrated a night vision system -- so handy for spotting guerillas – at last year's B.A. meeting and some members of the audience appeared to feel that this was not exactly value free technology.) The slides show something of the nature of the weaponry being used in Vietnam and its required rate of technological evolution – a tribute to Department of Defense contracts and the ingenuity of many U.S. industrial companies.

First, C.S. [slide 1]. This picture is familiar to us all, for C.S. is a British product [slide 2]. This cannister from Vietnam is virtually identical to this [real cannister], the Porton patent from Northern Ireland. What is different is the scale: over nine million pounds of C.S. have been used in Vietnam. There are only 18 millions or so people in the South – five cannisters for every man, woman and child? Nor has it stopped at single cannisters. C.S. is dropped from planes in cluster bombs [slide 3] and in liquid dispensation from helicopter gunships [slide 4]. This use [slide 5] is intriguing – a sort of ratcatchers' device, for pumping the gas down into tunnels and caves. The picture, by the way, comes from the U.S. Army field Training Manual of 1969, which also explains that the uses of C.S. are limited "only by the imagination of the field commander". Of course, the old style ortho-chloro-benzal-malonitrile of the Porton patent of 1960 has been improved. What is now used is C.S.2, an improved version bonded on siliconized particles of especially small, penetrating, and long-lasting quality. No doubt, if the war continues, further improvements are in store.

Next defoliants. The scale of use rose dramatically till 1970 [slide 6], until international scientific and public pressure following the revelation of the teratogenicity, that is, birth deforming effect of one of the agents, 2,4,5-T, introduced restrictions. Nevertheless, enough has been dropped to defoliate, and, according to the A.A.A.S. study, severly risk irreversible ecological damage to about half the mangrove swamps of the Mekong Delta, 30 per cent of the hardwood forests, and great areas of croplands [slide 7]. In addition, large numbers of Vietnamese women have been directly sprayed, eaten and drunk contaminated food and water. Increases in the statistics of birth deformity and still birth have been reported from the affected areas. In Hanoi myself last winter, I saw the deformed babies of three refugee women who had been sprayed while pragnant in the South. There were only three such babies, the statistical evidence is circumstantial rather than scientifically adequate. But in a war-torn society, where a third of the population has been compelled to leave their original home to flee to the relative security of the cities, or to be placed in concentration hamlets, human statistics are going to remain approximate. I wonder how many Laotian, Cambodian and Vietnamese babies will have to be born deformed, until we have adequate proof.

Finally, I turn to the fruits of war [slide 8]. The fragmentation bombs, formed and coloured like guavas, pineapples, oranges . . . each containing several hundred assorted steel pellets, and laid down in clusters from the so-called "mother bomb", by high flying planes. The contract numbers of the manufacturers are clearly visible on these. The steel fragments create a carpet of death, which can and does simultaneously cover an entire village. Only concrete or more than one metre of earth can protect a living body in this entire area. They can kill outright, as in this case [slide 9], where they have penetrated right through the skull and brain. More often, they wound. Hundreds of pellets may become embedded, two or three may cause paralysis or intractable palsy. Until recently, however, it was possible for surgeons to detect the pellets under X-ray and to remove many of them. A further technological innovation has changed all that: the new pellets are plastic – as deadly, but with a new advantage. They are invisible to X-rays. The surgeon can no longer find them to remove them.

So-called traditional weaponry has not been forgotten; napalm and improved napalm have been extensively used. The annual tonnage of explosives dropped in Indo-china exceeds the entire tonnage dropped in Europe by both sides during the whole period of the Second World War. Individual monster bombs, each weighing 7.5 tons have been introduced.

The point is that to discuss this kind of enormous involvement of science and technology as a pathological aberration is to invoke a conception of science as a social activity which is normally free from such flaws. In this conception, the use of science against the Indo-Chinese people, while it may be opposed, is seen as an *exception* to science, or even not part of science. Thus nuclear weaponry, pollutants, herbicides and toxic gases are separable and not an integral part of modern science. It is a bit like arguing that we can accept Oliver Cromwell without his warts, yet it is this wart-free, image of science which has been assiduously -- if not always explicitly – cultivated both by the élite within the scientific community and confirmed by the paradigm which has dominated contemporary sociology's conception of science.

The sociologist Max Weber spoke of science as a calling, a vocation, saying "without this strange intoxication, ridiculed by every outsider; without this passion . . . you have no calling for science and should do something else." This same metaphysic of science has been more recently repropounded by such diverse figures as the molecular biologist and Nobel Laureate Jacques Monod and the mathematician Jacob Bronowski. In both Monod's very recent book *Le Hazard et La Necessité* (1970) and Bronowski's slightly older *Science and Human Values* (1957) it is argued that the pursuit of knowledge is itself an ethical activity, and that the supreme goal is objective knowledge. Logically scientists have, or should have, a central role to play. In France it is whispered in the laboratories that this view of science should be called Monodtheism.

The sociologist must be forgiven for a sense of *déja vu*, for this is part of the same conception, the same paradigm which the sociologist Robert Merton formulated in 1937, and presented to the A.A.A.S. It was probably not an appropriate theoretical account then and it is demonstrably less so now. But before I suggest the main reasons why I think this paradigm should have fallen and been replaced I will remind you of its main aspects. First then, Merton says the scientific community has remained cohesive through shared norms and values, binding it together. Of these norms he isolated 4, which he believed to be of key importance. These are communism, universalism, organized scepticism and disinterestedness. Communism describes the moral imperative of publication, whereby knowledge although perhaps individually generated is a collective not an individual good. Secret research is thus the antithesis of science. Indeed, as Desmond Bernal put it, "Science is communism". The second value of science is its universalism, a norm which finds echoes in the writings of scientists as a belief in an internationalism of science which knows no frontiers; neither the race, the creed or the class of the scientist is of relevance in the consideration of his work. The way that the scientific community assesses new knowledge calls for an attitude of organized scepticism, thus the refereeing of a scientific paper and the checking of a grant application facilitates the critical and consensual growth of knowledge. Lastly, at the motivational level, the scientist is disinterested, that is he pursues knowledge for its own sake with recognition by the scientific community as the only reward. To seek publicity or power from the larger community is therefore to sell the pass.

This view of science as a more or less autonomous social system, self-regulating and self-maintaining, has not only dominated the sociology of science for 34 years, it has been in the main shared by the scientific élite. A little light is cast on the nature of the model and its relationship to a liberal democratic theory of society when we see how in the middle fifties in the height of the cold war and McCarthyism, the sociology of science experienced a revival of interest, and the concept of the *Communism* of science became politically renamed the *communalism* of science. Of course Merton's model was proposed when Nazi Society was making scientific work impossible. Consequently if Nazi values and scientific values were antithetical to each then those of liberal democracy, where science flourished were perhaps synonomous.

Yet this does not explain satisfactorily the grip of this ideology of the autonomous scientific community. Quite recently for example a young radical physicist wrote to me in great excitement. He had just read Merton and felt that here was the key to understanding science and issues of social responsibility. Nonetheless, despite a growing dissatisfaction with the paradigm, a convincing alternative has not been propounded by professional sociology. It remains defended by three decades of Columbia Ph.Ds. and secure in the knowledge that for the most part the scientific élite is not merely part of the paradigm but actively approves it.

It is as if the scientists polish their self image everyday as men dominated by scholarly values, any deviation from which, such as secret research or the pursuit of power is either conspicuously absent or causes conspicuous distress. In reality scientists, particularly those who speak for the scientific community frequently know a very great deal about secret research and are close to the counsels of the State. They appear to be neither tormented by secrecy nor disinterested in power. Despite the enormous percentage of the science budget of contemporary capitalist – 78% of the U.S. budget and 56% of our own – and state socialist budgets, still devoted to defence and space research, and the manifest and enjoyed power of those who advise the state on these issues, at the same time, these same scientific mandarins are often those who preach the autonomy of science and its sacred values. Because Galileo was profoundly sceptical about the existing state-backed theory of the universe, and through this scepticism came into conflict with the authorities, it is implied that inside every white coat there is a Galileo, the mythical sceptical internationalist, disinterested and communistically minded scientist simply waiting to emerge.

They cling to a folk memory of being martyrs for truth, when apart from Galileo, it is difficult to cite the martyrs. Even those destroyed in the worst period of Soviet science, during the late 30's and early 40's, were destroyed as part of a generalized problem of Stalinism, rather than as a particularly scientific problem. In fact despite the aggressive "*nullius in verba*" of the Royal Society, and the subsequent emphasis on the purity of science, the early Fellows never drew a sharp distinction between royal Charles' navigational problems and weighing air. The rhetoric about the purity and the neutrality of science which expanded from a statement about the character of scientific knowledge to describe a political stance was fostered even while élite scientists worked very closely with both State and industry. The irony is that while science becomes increasingly specialized and fragmented, those who simultaneously retain their integration over the most theoretical and the most sophisticated applications of their discipline are to be found in nuclear physics – with Oppenheimer as the archetypical new scientist.

It might be argued that the interlocking of the physicists with the defence establishment is a unique event and is not generalisable. Equally it can be argued that the full impact of the biological revolution is yet to be realized, so that while many biologists – like Rutherford and Hardy – assure us that such applications and involvements are inconceivable, we might consider, for example, the appointment – in say 20 years – of Dr. Crick to the Chairmanship of the Euthanasia Council (of course by then he might feel it more appropriate to set a practical personal example); Drs. Edwards and Steptoe as senior consultants at the Aldous Huxley Institute of Baby Transplant; Professor Eysenck to advise on the Voluntary Sterilization Programme for those with low I.Q. genes. Lastly dare I suggest that Mr. Maddox might announce the launching of a new journal The Pangloss Journal for the study of Public Reassurance; but it is necessary to turn from such visions, part reality, part fantasy, to the last and hardest part of my talk. What is to be done?

What then is to be done? To answer this, I must first explain what must *not* be done. There are three don'ts for scientists. Don't go on an egotrip of social responsibility, don't drop out or turn to social science to solve the problems, and don't look for a "technological fix".

To take these in turn. Beneath the apparent frivolity of my futurist suggestion lie a range of possibilities, which could be called the realization of the Orwellian Huxleyian nightmare of eugenics and the manipulation of mind. Nor are these schemes so far away; in the United States we have reliable reports of whole classes of schoolchildren routinely being given tranquillizers, and neurologists have reported work which consists of putting electrodes into patients' brains so that the psychiatrist can control mood. These are fragmenting indications of a process, whereby science which was to be a liberating force to enable men to understand and control the nature has become the Juggernaut of rationality which aids the oppression and exploitation of man. It is not just in Solzhenitsyn's *First Circle* that science and technology are means of repression – even against those who do it.

What is to be done? It is doubtful how much use some of the personal agonizing about responsibility is, or for that matter Hippocratic oaths for scientists. While this *is* personal responsibility, and it is as well for a scientist – like anyone else – to know what he will and will not do, the real issues are not those of personal morality alone but are issues of politics and economics. The institute for say cloning people – a whole series of Lederbergs perhaps – will occur as a result of a series of decisions to back research and development in this area; and even if most scientists elect not to work on it, some will – and unemployment is growing. The few may be more than enough; here no ego trip of personal responsibility meets the need.

How about dropping out? Confronted by Doomsday reality many young scientists are unable to bear becoming part of the machine. In the British Society of Social Responsibility in Science, several of those who were most concerned by the social implications of science – and not windbags, very hardworking people – have in fact left science. Some drop right out, others look to the social sciences for a greater humanity. I have some doubts about both, and natural scientists should certainly be cautioned about the social sciences which have their full share of ambiguity. The Americans have the most flagrant stories, particularly of Project Camelot, the multimillion dollar programme studying insurgency in Latin America. All paid for by the C.I.A. Nor is the C.I.A. stinting; it has supported foundations and journals in Europe, and, in its time taken more than one of us for a ride. Indeed, only last week I learnt of a conflict research project on Northern Ireland, whose sponsoring foundation certainly used to be a C.I.A. front. So there are no easy paths to avoid complicity.

As for pure dropping out, it seems to me to be a personal solution which gives up hope of a societal solution.

One course of action would be to ask the scientists who helped us into the mess to get us out – the ideal of a "technological fix" is attractive both to optimistic futurologist and to one tradition of mechanistic Marxists. These have clung to the belief that if the technological transformation was radical enough, then society would change. They hark back of course to Marx's argument about the association of the steam mill and the rising bourgeoisie. What they have not perhaps seen is that none of the new technologies belong to a rising proletariat; radical innovations may be introduced but they all belong to the bourgeoisie. So if dropping out solves little or nothing, neither will mechanistic Marxism.

These then are three blind alleys of activity. What then is left for us? The shorthand phrase which expresses, for me, the only way through the problem is the slogan "Science for the People".

What does this mean?

Typically such decisions as Concorde, Blue Streak, RB211, the British H-Bomb are taken by tiny numbers of people. Ordinary scientists, let alone ordinary people, are simply not going to be allowed to discuss and decide the proposal democratically. It is only when the project falls flat on its face that even the financial committees of the House of Commons notice it. Then when the horse is well away, our representatives can democratically discuss which way, and how, and when, to bolt the stable door.

If we are to assert social and democratic control over a scientific and technological decision making in advance and not too late, a main task for scientists will be to study and expose the political and economic structure of science, as only by getting the relevant information at the relevant time is there any possibility of social controlling action. This is an essential part of the work of combatting an oppressive and dangerous technology – whether it is CS or an A.B.M. system. Some physicists have been doing this for 25 years as their contribution to getting the people to hold down the lid of their own particular Pandora's Box. It is probably time for biologists and social scientists to start doing the same. Not all the issues have such continuously high stakes, but the scientists must learn how to publicize, agitate and organize.

But information alone is not enough. The crazy contradiction of the openness of information and the closed control of American society is a continual warning. Control is also vital. Knowledge is only one key to the double lock of this control, the other is power. Power which must be widely shared both by the scientists and by the people at large. For science is not merely too important to be the only thing a man does. Solzenitzhin's Nirzhan was right, better a lower circle of hell than only to do science mindlessly in the first. Yet to find time to think about, and work at, making science responsible, to take time off from doing science itself indicates that there has to be a dramatic change of relationships within the laboratory. It also means that science may not make such rapid "progress", as a singleminded pursuit may yield. Yet these losses seem in prospect to be more than likely to be fully compensated. That is of course unless you are a Monodtheist.

Finally practical action. Moralizing about what ought to happen is only half a struggle. The skills of the scientists can help directly by combating specific oppressive or dangerous technologies like CS or an A.B.M. system. Sometimes too, counter technologies may have a useful role to play, a reliable device to see whether a telephone is being bugged would be useful, and so would a modest scrambler device. We can learn from the Soviet dissenter Medvedev of a variety of ways of checking our post. A variety of other less respectable but very useful technologies could be readily generated by fertile minds with appropriate training.

Science for the people is inevitably preoccupied with looking for ways which democratic control can be asserted over a burgeoning science and technology. While the democratisation of the laboratories themselves is one part of a programme, democratisation must also involve the enfranchisement of the mass of people who are disenfranchised by their technological illiteracy. This illiteracy is not a chance phenomenon, it is the product of an educational system which defines some as élite experts, and the rest as illiterates.

The problem that science, and for that matter society, faces is not an acute – a once and for all – crisis in science, but a chronic condition, whereby a world made one by massive science and technology lurches either towards barbarism or human progress. Survival itself now demands revolutionary changes in society, and one of the pre-conditions of this is the mobilisation of scientists.

Where once revolutionary activity was argued for as a guarantor of progress, we now have to argue for its necessity as a guarantor against barbarism.

Discussion: *De Senectute*

Peter Avery talks to David Clark, and Oliver Hodgson, consultant psychiatrists at Addenbrooke's and Fulbourn Hospitals, Cambridge.

Peter

The state of our civilization is reflected by such factors as whether we are selfish towards the aged or not: our spiritual values are shown by our behaviour towards old people; and we can be concerned with this for ourselves in more ways than one. We can be being presently cruel, which is a bad thing for us; also we can be being masochistically cruel, because we are being cruel to ourselves in the future, as we too are going to be aged, which is why the problem of being aged is such an intimately personal problem. Another point is, there should be no hardship in associating with people older than ourselves, because they have so much to give us; so much to tell us we don't know, such charm very often. Of course, we must remind ourselves that not all elderly people are as charming as others; for example there is the senile person – the real "patient". Can one always have the requisite degree of *patience* to cope with the old person who needs much looking after? I'm very concerned with this aspect of civilization, this overall social aspect of our relationship with people older than ourselves. I use the word "civilization", though of course one may find in a so-called barbaric society a very rational and proper procedure towards older members.

David

I would agree with you that one test of a civilization is how it deals with its unfortunate and deviant members. Oliver and I spend our lives looking after groups of people in this category, and feel this strongly. There are quantitative aspects to it too.

The mentally ill, who are our immediate concern, are treated much better by our society than they were a generation ago. The number of mentally ill in institutions is now much less, but the number of quite helpless aged is much greater than it used to be. The facilities our society provides for these people are constantly strained and therefore inadequate, and therefore we get scandals. I think, too, that people feel the burden more because there is a greater demand being made both on the official organs and also on people's sympathy than they bargained for. Thirty years ago if you had an elderly relative you knew that kind fate would remove him fairly soon after he became incompetent. Now this isn't true. So there is the problem of the place of the elderly in a society that says people become useless at 65. And the great question is that in the last 20 or 30 years the doctors have acquired an extraordinary ability to keep life going on, to mend broken aged bodies and keep life going when intellectual life is certainly extinct, so that you have more and more people living for 2 and 3 years in a cabbage-like state.

Peter
So you are saying society has not caught up with this particular branch of medical skill? You are approaching the matter, if I may say so, from a rather institutional level, whereas I was thinking in terms of more personal private relationships. One of the things that occurred to me while you were talking was, what is your view of the collapse of the old established family?

David
We always have a sort of ideal picture in our mind of the extended family of the farm with the farmer and his family, the servants, the people in the cottages around, a gathering of say 40–50 people; and there of course the aged grandfather sitting by the fire minds the baby, tells stories to the young boys, while the aged grandmother has her place, and even the helpless aged can be carried perfectly well, though, as I said, there weren't all that many of them, and if anything is rare you look after it with greater care. But when you get the modern nuclear family, father, mother, two children, and as soon as the children become adult they set up their own nuclear families in suburbs of a big city. . . .

Peter
Probably different cities. . . .

David
Then the problem of the old person living perhaps in a bed-sitting room, lonely and immobile, is a very tragic one.

Peter
Do you think these so-called Sunset villages in the U.S.A. are an example of a valid attempt to catch up with this problem?

David
I've never been to one, so I don't know how it works. One of the

things they do in the States is to isolate specific groups of people. They put negroes in a ghetto. Porto Ricans in a ghetto; they have societies of teenagers; and in that context it is quite reasonable that they have towns and cities down on the warm south coast which are entirely inhabited by retired people.

Oliver

I think that is terribly bad. You should have three generations growing up together. I don't think modern people are worse than people were before. When Peter Townshend did his survey in Bethnal Green in the late 50's he found most of the old people were in contact with their children, and there was good rapport between the generations. What we have done in the last few years is to move people into nice hygenic surroundings where the generations are artificially segregated, and you don't get the situation where the children went out to work and their children were looked after by their grandparents, and in return Grannie and Granddad got some support from their children.

Peter

May I pick up a remark David made when he talked about how "society deals with its unfortunate and deviant members?" I take it he was thinking of institutions. But you could say that the people who are growing old as has just been described are just the opposite of "unfortunate and deviant". They are fulfilling their lives just as they should do. This brings up the difference between the aged who are O.K. in that way, and the aged who are not.

To interject a slightly different trend, what about what I'd call mystical awareness? Traditionally the aged are supposed to be better at this than the young. So we have a particular concern with something in which age can improve excellence, whereas it can't improve excellence in say cricket beyond a certain amount. Now of course, there is what you two have described as the institutional aspect – and you are brought up mostly against what you can call the unfortunate aged. But I want to think about the exceptional aged. If there is something you can draw the attention of just everyone to, because most of us are going to get old, as an important thing to which they can aspire, then this is surely a very worthwhile thing. I just want to ask if you can keep this in view.

David

I think there is a more interesting question than these others we have been talking about and that is the role of the old person in society. I would say quite strongly that medical skill and other things are creating a very large part of the British population who are at present put in a useless disadvantaged position which is miserable for them and for others, and that one of the big tasks our society faces is of creating more roles for people in their late 60's and 70's and early 80's, and that we are not giving enough attention to this. We are not looking at our retirement policies at all sensibly. There has been quite a lot of pressure for a Royal Commission on the subject but this has never come off. In former Chinese society you spent most of your life waiting to get old, because there were so many advantages in being old. I have talked to women in Japan who said they were living for the day when their son got married, as then they would have a daughter-in-law; what they really meant was, a daughter-in-law to bully! So their adult life was an apprenticeship for the good time when they became aged. I think this used to be true of our society; the position of the revered elder person was something people yearned for and prepared for. One of the terrifying things nowadays, is that this is no longer available as anything like such a gratifying goal. The number of areas now in which an aged person can speak with confidence, knowing that he is more knowledgeable than the 20 or 30 year old, is getting less and less.

Peter
This may surely relate to technological fields and some aspects of science, but it is not relevant to the experience of life in general or spiritual experience.

David
But my children say to me, "You have never 'turned on'. You don't know", and they believe they have plumbed frontiers of mystical experience with various drug experiments and I am a poor creature trapped in my aged and inhibited framework.

Peter
Don't you fight back on that?

David
One thing one does have is 30 or 40 years of adult observation of human behaviour and memories of one's own behaviour to fall back on. This is something the elderly person who retains his wits has, and the young have not. When they are faced with the problem of

bringing up another generation, the grandchildren, then one can fight back, but I don't think one can fight back to the teenagers because they don't want at that stage to listen – the gap is too wide; in another 5 or 10 years it will have narrowed.

In the past the things a man of 20 had to know were the same as a man of 70 learnt 50 years before, now this just isn't true. Not only technological things, but the whole process of living has changed so fast.

Peter
A hippie type young man once said "We can get on all right with the old, it is these ghastly middle-aged we can't do with". It's a question not of whether the old have been turned on and know the latest about computers, but whether they have some of this deeper thing – can you call it wisdom? – that the young can recognize.

Oliver
About the old versus the middle-aged: the old are more content to let the young have their say and not to quarrel and struggle with them, whereas we are struggling with our children who want us to retire so that they can take over. The elderly have retired.

Peter
They may have come out into a kind of blue-azure world on the other side and this makes their presence and conversation very attractive to young people.

David
I think the question of giving up power is very important. I was very impressed by the arrangement in Japan. At the age of 60 you can firmly retire from being head of the family. You have a party and hand over. If you are a shopkeeper you hand the shop over to your son. It is all quite institutionalized. Afterwards the old people go on pilgrimages.

Peter
It is good if you can feel you are starting a fresh stage in old age which is not just a hangover from what you have done before,

Oliver
The nice thing in Japan was that this was recognized and institutionalized, so that everyone, both the old and the young, had

certain advantages. But I think we are talking about a tiny group of people, those who are relatively intellectual and successful. The majority of people aren't. The man who has only unskilled muscle power, when he is forced to retire, has something society doesn't want whereas women can go on running a house. The vast majority of old men have no status at all, so they are just sitting in the twilight.

Peter
They are pathetic shadows, aren't they? But is this a problem of age, really, or is it an awful human problem? Life is so unfair – some people seem to have inner force and some don't – though I do see it comes up sharply in age where it does seem to me that people differentiate rather definitely into those who have made it and those who haven't. In addition there are a large number of people who could make it and don't, and go sour and are a burden to others. Of course this inner force that carries on into old age is something that has got to start growing long before you begin to get old.

But how old can you get?

In local histories in England there are references to longevity which are related to locality – climate; quality of pastures – environmental factors. There are said to be people in Georgia, and the Caucasus who live to be 160, and are said to eat yoghurt. . . .

Oliver
Exact documentation of ages is very tricky in cases like this. The best documented social group is the British Peerage, and it is only recently that one peer lived to 100. Living to a century is very rare and I suspect that is so even in the Caucasus.

Peter
I am reminded of an old Persian friend of mine whose father was notorious for having lived to a very great age and he was asked the secret of his father's longevity, and he said "I will give you three guesses". The interlocutor said "The village he lived in was very healthy" – no, it wasn't that. "The water in it was very good" – no, it wasn't that. "The father was a religious man and therefore regular in his practices, prayer times and so on". It wasn't that. So he said "What was it?" and my friend said "My father was the head of the village. It was *Headship* that kept him alive so long".

David
Certainly one thing we all see is the person who holds on to his

professorship or chairmanship, until finally he is dislodged – and then he is dead within the year.

Oliver
There are a whole lot of environmental factors here. One thinks of the person who has developed the hobby so when he retires from his insurance office, or whatever, he has got this thing that has been going along for years, and he has been looking forward to that as much as the Japanese lady has been looking forward to being looked after.

David
I think the Jungians are absolutely right in saying that if you can do a certain amount of psychological preparative work for the next life stage, you may be able to fill it with more satisfaction for yourself and for others than if it is allowed to come as a horrid surprise.

Oliver
But there are the people who have physical setbacks and feel they are a burden.

Peter
They begin to apologize for their infirmities.

Oliver
To be old and infirm is a frightening and worrying thing and it is only a very exceptional person who can bear to watch his steady decline.

Peter
Has this always been so? This seems to be some kind of indictment on our society, that we should find "anno domini" a frightening and worrying prospect.

David
I think there are two considerations. One, we have a society that, like the American, puts a strong accent on youth and vitality and vigour and "get away" people and "go", and that kind of thing, so that if you are not vigorous you feel at a disadvantage. Then there is the fact that the decline is much longer and slower now. Many people have been successful because they liked doing things, and to see themselves becoming unable to control things is one of the most frightening things that can happen to them.

Peter
It seems to me that for some people a lot of the kick in life, at any rate for the young, depends on exercising one's powers, not necessarily actually controlling other people but being in the swim and

holding your own. And then you look at your increasing age and think "at a certain point I shall cease to be able to hold my own and be forced to rely on other people being nice to me, and I shall not be able to force them to be nice to me". That of course requires a different kind of development in what can be called humility, serenity, something pretty tremendous which not every one succeeds in doing, in order to become in a real sense an attractive and genuine personality. It must always have been pretty rare that people have achieved that. How are you going to give people the know-how, so that they see this is what they have to struggle for, so as to achieve a quality this is independent of having power and battening on other people? Then you have got something more valuable than what you had earlier.

David
There are some life styles that fade very nicely into old age. If you have always worked on a passive manipulative basis of being somewhat pathetic, and encouraging other people to do things for you, this blends into old age very effectively.

Peter
Very effectively for you, but it doesn't exactly make for the kind of old person people want to be with.

David
On the contrary, you have learnt to enjoy people being kind to you, and your life style depends on giving nice rewards to people who support you. But the person whose life style depends on controlling and dominating and managing, finds it is almost impossible to move into old age gracefully.

Peter
You contrast the person who has always been lazy, passive but commanding service by "charm", with the kind that likes controlling, and you say the former get on better in old age. This I can't accept. It seems to me the person who has been very active, forceful, and done a lot of rather considerable things should be in a better position to go into a proper old age because he withdraws and the other people find it necessary to come to him. On the other hand, it can be said that the person who gets himself looked after by various personal skills and charm is the person you get on with. The other category is the looker-after, and that person is completely ditched

in old age, because people have been accustomed to being looked after by him or her, and don't rush to *do* the looking after. But can't we say more about the business of preparing ourselves for old age before it comes upon us; laying in, as it were, what might be called personality and spiritual resources, to be drawn upon as equipment with which to cope with being aged and to be attractively aged? So far you have both been rather depressing.

Oliver

Society doesn't help much. One is forced to retire at 65. There is no magic about 65 but there are insurance and superannuation schemes and people are told they should retire at 65 with no thought of what they should do or how they should live. Society itself throws them aside.

Peter

With the remarkable exception of judges and bishops.

David

Most professional men in fact, like dons and doctors, have various ways of beginning to take on things which go on well into their 70's. They can stop when they can't do it any more, and they don't have this automatic cut-off. I think we can say most of the middle class professional groups have found ways round these cut-off problems.

Oliver

I think we should offer more opportunities so that people have more control over their lives than in the past, and look after the skills people still have to offer.

David

I am sure this is something society is looking at and will continue to. Coming back to our ideal farm society, I once met an old man who was coppicing a wood, and he said it was the third time he had coppiced this wood, which was done every 20 years. The first time it was as a young man with a coppicing gang when he was about 20. Then the second time was when he was about 40, and he was the foreman of the gang and they were doing it on contract; and now he was about 60 he was doing it on his own at his own speed. One of the things is the relinquishing of power and responsibility. Most of the people are at their best in terms of exercising power and responsibility between 45 and 60. They can go on after that doing skilled jobs but they don't want to have the burden of worrying about what other people are up to. We make this possible in hospitals. We have made it possible for older people to have rewarding jobs where they are not in authority. The idea you have to go on being promoted and then stop is something society has got to look at.

Peter
How do you plan for this?

David
I think you are asking the wrong people. It is a mistake to ask doctors how you should keep healthy. Doctors are skilled in treating disease and they tend to know how people should avoid disease, but of course leading a good life is not only this, and the sort of thing we need is study by sociologists and others of successful old age. This study is hardly being done at all, and we doctors only see effective people by accident. There is a lot we don't know about both the physical and the psychological side of people who have made a successful job not only of old age but of middle-age. From studies of this there may come knowledge of patterns people can adopt or work towards. As it is, except for individuals who have painfully discovered it for themselves, not much is known about living out your 80's in London suburbia.

Oliver
Also so much is hidden away nowadays in hospitals. There are a number of people who have never seen a dead person and a vast number haven't had anything to do with the birth process, so there are fantasies at either end of life.

David
Again, within the nuclear family it is quite possible not to see anyone through the senile process. I remember someone saying what a pity it was the colleges were forcing their aged fellows to depart at 65. He said it was a most valuable *memento mori* to see someone gently dementing in front of your eyes.

Peter
Some would perhaps say, it is rather grim if the sight has to be something like the grinning skull of *memento mori*, but it can be also a heartening process. It is certainly something one ought to know about, as Oliver says. Is there anything in your profession which you say to people who are actually going towards death? Do you tell them not to think about it? Or do you tell them, on the

contrary, to think about it and plan for it rather as the Yaqui sorcerer says the man of knowledge faces his death at every moment of his life? Or if that's a bit extreme, what do you do?

David

We aren't quite the right people for this, are we, Oliver? We are dealing with people most of whom become demented before they die, so it is isn't a question of calm discussion of how the process should be. This is a great question, and generally speaking most doctors are pretty inadequate at dealing with it. There is the great medical-nursing conspiracy to deny death and not talk about it, certainly not to the person who is dying. One hopes there are good physicians who do help people to look at the question of how they are going to die, and how they are going to prepare for it. Fifty years ago when the physicians were mostly convinced Christians who regarded a good death as the crown of a good life it was much easier than now, when people are uncertain of their religious faith and the idea that a good death is something to strive for and practise for is rather out of fashion.

Oliver

Yes, I am sure you are right. I remember after I was qualified asking "What does one say?" and I was told "Never tell them because you can never know how they will react". A lot of people might become frightened and worried, and this is something a lot of doctors wouldn't know how to handle. I'm sure I'd make an awful mess of it and I expect you would too, David.

David

Certainly I think this question of the art of making a good death is something which is not studied in our society at the present time. This is a grave loss and I don't know that we shall ever come back to it.

Peter

There are said to be Yogis who, when they think the time has come, can quietly switch themselves off.

David

In the oriental societies, the end of life is as important as other parts of life and there is a good deal of thought given to making it so, composing yourself to die at a time and in a way that isn't a nuisance to other people. In our society suicide was until recently a crime and it is still quite difficult to take your own life. I can think of two suicides. One was an arthritic woman who said she would take her life when she became helpless, and she did. The other was a Judo master till he was over 50, and then when he could not practise any longer, he killed himself.

Peter
That sounds as though he had put all his eggs in the Judo basket.

David
He always said "This is my life, and when I can no longer do it, I shall stop living", and he did.

Peter
This does seem to be where we get to the basically atheist metaphysic in the midst of which we live. Perhaps that is too big a question?

Oliver
We doctors are so concerned about people's bodies we tend not to worry about these other things. I think all doctors tend to avoid these questions in their professional life, and think "My business is with this person's body alone".

Peter
We are prolonging life and forgetting how to live. One thing that has been said that is very interesting at least for me is that religion can be a great tidier up of life, certainly in preparing to die properly.

David
Certainly some philosophy is needed, which encompasses all of life, failure and incompetence and failing powers and dependence, and isn't only one of success and go ahead and get ahead and get to the top and make more and so on. This is what is so limited about the generally accepted philosophy of our society.

Oliver
I think religion at least enables us to say goodbye to people decently even if you don't believe in it very much. I realized this when I went to the funeral of an atheist, and there seemed nothing in it for anyone.

David
Then they were incompetent atheists. I have been to a memorial service for an agnostic which seemed infinitely better than the hurried and shabby rituals of a minister who has been paid to put a Christian under quickly.

Oliver
That is an unfair comparison.

Peter
Religion can come in not only as a matter of beliefs or of *rites de passage* but of nurturing this inner spark that can go on growing, and old age may be a time when it has particular opportunities for some sorts of growth.

Oliver
I think of the biological facts of life. Even life decaying around you in the autumn, can be most pleasant. When living things grow old they are often multicoloured and are treasured. You can feel yourself part of this changing pattern and even feel that you too will be quite presentable in the autumn of your days. Even winter too can at times be very pleasant. We get so far from feeling part of life.

David
What do you mean by "life"?

Oliver
Well, I think I am part of the stream of life. I am not going on for ever for if we went on living for ever we would make life impossible for the next generation.

Peter
Aren't you saying that there is a distinctive quality in each stage?

David
We are getting back in a sense to the farm and the natural processes and changes that go on.

Peter
At the beginning I was rather hesitant about starting off on what you might call a spiritual tack, but it is interesting to me that the conversation has come back to what you might call spiritual values. To be less vague, what for me has emerged from this discussion is

that in the modern West our problem is old age's having become untidy, socially awkward, embarrassing. Life lived under a sense of the pattern, the guidance, furnished the human spirit by a religion faith does not admit of this kind of untidy awkwardness; each stage is prepared for, and especially the late stage, when the kind of wisdom which is what deep religious faith is, should be at its most mature.

Note by Julia de Beausobre

Declarations are in vogue about a civilization being judged by its attitude to old people who were better dead but do not die when it suits their community best. Yet discussions of concrete situations seem to play down the opportunity which very old people need most: fruitful leisure in solitude – as distinct from a drift into useless, immobile loneliness.

By the time we have become noticeably less alert, the bulk of our general understanding increases and deepens remarkably, as if a different part of the brain – a fresh or well rested part – were taking over from an outworn part which for years has been selecting with incalculable speed the particular sense which at any moment has to be given immediate priority over every other activity. The shift in predominance from alertness to overall understanding in depth creeps in unnoticed if our mental energy does not begin to flag before the body is sufficiently outworn to begin tangibly to expire. But however stealthily the shift comes, it can and should be anticipated and prepared for, by the ageing themselves with adequate support from the community they form part of. And the provision of help, for them to begin helping themselves, early enough, is incumbent upon all.

Once the very old have been given suitable shelter, nourishment, and physical aids, their leisure in solitude would hardly need any further outlay of money. But it would require of the entire community a significant mental re-adjustment; because the force used in gradually creating for oneself the leisure that bears fruit in solitude is prayer of the kind that develops an individual's latent ability to penetrate, and then to continue within, the abiding peace of that which the particular person concentrates on or prays to. In the Christian tradition the penitent prays for the peace of Christ; which is granted by the Almighty. To weigh the distinction between "for" and "by" is important because, when the mind continues active in a crumbling body, concepts (whether narrowed down to one word or contained in several words) acquire a new creative quality. They move out of linear formation and, freed of logical linkages, regroup into clusters or patterns that can be called harmonies. To live in a harmony of concepts is unlike stopping to enjoy for a while a harmony of emotions. No emotion belongs in the sphere of tranquillity; but harmonies of concepts are part of it, and they are fuel for the fire called divine love.

Through continual prayer a physically worn out person's tranquillity becomes highly charged when, without its ceasing to be a state of mind, it becomes in his experience the ambience, or climate, or atmosphere, or "soup" in which new events have their setting. These events amount to that person's awareness of processes that have a direct bearing on his posthumous new body. They are physical but not carnal processes (in this resembling the events observable in chains or clusters of molecules) and as death approaches, they are already being programmed to suit mankind's new day, sometimes conventionally called the day of the Lord. For a Christian the awareness of the new processes arises through a multiplicity of reciprocal acts between the Christian's personal God and God's praying creature. But for this awareness to run its true course and become an experience, worn out people need much leisure free of external stress.

To say more would hardly be useful, since, when tranquillity is perceived to be not only a state of mind but also an ambience, then the word "intention" becomes interchangeable with the word "achievement"; much as – in some thought systems of those who study cybernetics – "purpose" is found to be interchangeable with "causality". (See Grey Walter in *T. to T.* July 1971.)

The newfound equivocation precludes easy verbal communication. Yet this stumbling block need not prevent the energetic young and the robust middle-aged from accepting on trust that their helping to provide old people with as much leisure as any one of them can put to good use, will prove profitable to the entire community of man. An occasional timely leap over a stumbling block by a few people can give widening social circles the impetus to move in a new direction with vigour.

Shamas and the Trance I

an ethnographic study from Buryat shamanism

Caroline Humphrey

The Buryats described in this article are a Mongolian people living in the Lake Baikal area of South-East Siberia. Some groups of them were converted in the 18th century to Lamaism, but others retained the animistic beliefs and practises of Shamanism, which form the subject of this paper. The author has read extensively in the ethnographic literature on the Buryats and also did field-work in collectives of the Buryatskaya A.S.S.R. in 1967.

Human beings have an equivocal position in the cosmology of Shamanism. It is a consequence of the belief in a multiplicity of souls that, to the Buryat, a person (that is, a human consciousness) need not always be where his body seems to be; and, in everyday life, a man does not expect to be conscious of what his soul may be doing. The idea that, without losing their individual personalities, the souls of certain people are transformed after death into the spirits of animals and natural phenomena, means that human beings are surrounded on every side by natural things which are not what they seem; – in mountains, animals, and trees, and hidden by such an existence are many fully conscious, aware, desirous, individual beings. There is therefore in this world, – but greater than it, extending also to other regions of the cosmology: the skies, the air, the earth, and the underworld, – a further reality, which people only fully realize when they die and become part of it.

The spirits (*zayan*) are invisible. It is true that they may reveal their presence to observant people by signs: a dog which pricks its ears up like a wolf, is not simply a dog. There are divining techniques, such as the reading of the hair-cracks on a heated sheep's shoulder-blade, which help people to interpret the signs. There are books, among the Mongolians and literate Buryats, telling exactly where, in a particular situation, the invisible powers must be:

> ". . . the spirits which took away his life have gone into a yellow dog if there is one in that tent. If not, they have gone to a tent towards the north where there is a black dog and a black bull. They are enclosed in a deer-skin or a cracked mirror or a jewel.

In seven days they will return to the deceased's tent and settle in the big daughter."[1]

All kinds of harm among human beings are caused by spirits. Therefore, after a disaster, or to avert a misfortune, trouble must be taken to find out which spirit may be involved, where that spirit may be residing, and the individual character and tastes of the spirit. Upon this depends the details of the rite performed specifically to the requirements of the spirit. No detail is neglected. A Mongolian instruction book indicates, for example, that for one spirit:

". . . the man to be employed in the rite, – if you employ a man with a blue complexion, good manner, careful of speech and thorough in knowledge, slightly affected with gonorrhoea, clever and a liar, inclined to crime, – then it will be performed without bad effect. . . ."

Ordinary people cannot know with certainty which actions of theirs may turn out to be harmful, – they cannot realize the full extent of the other reality. The instructions of the books, and, among the illiterate, the injunctions and wise words of old people, although they are based, according to the Buryat, on experience and even revelation,[2] are nevertheless insufficient, unreliable like the strategies and deductions of a man with only intermittent sight. People know this because, in brief flashes, they are able to enter momentarily and perceive the other reality: i.e. when they are dreaming, and when they are in certain kinds of trance.

People may enter the other reality with their wandering souls, when the body is left behind without consciousness, as in sleep, coma, intoxication and certain trance-states. Buryats say that all knowledge about the other worlds, the skies, the air, the underworld, the metamorphosis of spirits, their places, their pathways, and their habits, must be obtained while in such a state.

It is also true that the other reality may, in a sense, enter the human being; that is, voluntarily or involuntarily, the human body or mind may be entered by a spirit, and then, depending on the

[1] Quoted by C. R. Bawden in "The Supernatural Element in Sickness and Death according to the Mongolian Tradition," Part 2, *Asia Major*, NS IX, I, p. 153. The manuscript is H 68 from the Hedin Collection in Stockholm, translated by Bawden.

[2] This is certainly true of the oral instructions, proverbs, sayings, etc. of the shamanist Buryat. The books, on the other hand, are written by lamas and almost certainly contain an element of mechanical copying of Tibetan precepts foreign to Buryat supernatural experience in dreams, etc.

relative strengths of the subject's souls and the spirit, the subject will then be forced to feel and think as that spirit. In other words, the subject is "possessed". Thus, some people who are subject to certain states of dissociation or trance (but different from those mentioned above) have direct experience of being a spirit. This is the way to learn about individual spirits, their histories, desires, and weaknesses.

It is a necessary part of both of these mental processes that the subject should lose consciousness of everyday reality in the normal sense; (he should in any case close his eyes and cover his face), and if the subject is nervous or self-conscious and cannot achieve the necessary state of dissociation, then the trance has failed – or, as the Buryats would put it, the spirit has not come, the soul has not reached the world of spirits.[3]

Since this is so, we may assume that the actions and words of the subject who does reach the necessary state of trance are the expressions of his unconscious,[4] and that these manifestatinos are directly associated by the Buryat with spirits and the reality of spirits.[5]

The English word "unconscious" in its everyday usage suggests that the gestures and speech of the person in a trance, sleeping, delirious, etc. are apparently random and certainly personal and individual, that is, emerging from the unique experience of one human being. But here, on the contrary, the ethnographic material shows that when a Buryat is in a trance, every movement, sound, and word, may be determined and expected, and, at the least, will have a socially expected form. In these circumstances, it would be impossible for the Buryat to use a merely negative word, such as the English "unconscious" – which indicates rather a significant interval in our own culture – for these mental states. The work of Freud has, of course, shown conclusively that the manifestations of the unconscious are never random,[6] and that they have forms which are

[3] This is documented by Khangalov for the Buryat, and, in more detail, by Shirokogoroff for the Tungus. I am using the word "trance" here to mean a state of altered consciousness which is recognized as such by both the subject and the society. S. M. Shirokogoroff, *The Psychomental Complex of the Tungus*, London, 1935, p. 333.

[4] Here I refer only to what is descriptively unconscious, but later, as should become clear, I use the word to refer to active yet unconscious ideas.

[5] In cases of spirit possession the gestures, etc. of the subject *are* the gestures of the spirit.

[6] In, for example, S. Freud, *The Psychopathology of Everyday Life*, (1901), tr. A. Tyson, London, 1966, where he shows that numbers chosen "at random" are determined in the unconscious.

its own partially controllable, incompletely perceived body is substi-determined by human, or at least cultural, processes of thought, and are therefore not personal, except in their content. Buryat culture has recognized these facts in its doctrine of "spirits".

The word which the Buryats use in this context is in fact a positive one, *üjemerle-* "to see what there is to be seen,"[7] and the person who is able to enter a trance state and thus perceive the other reality is an *üjemerchi* "one who sees what there is to be seen." The Khori Buryat Tugultur Toboyev defined this word carefully: . . . *onggot-i iriju irigüleged doturaban orogulba kemen tere onggon-u nere-ber bögelejü bayiju üjemerlen bui* . . . ". . . to invoke the ongon (spirit) and make it enter, and then to shamanise[8] in the name of this ongon, stating that it came in, is called *üjemerlen*. . . ."[9]

It is this process which I wish to examine in this article. When "seeing what there is to be seen" involves not merely the closing of the eyes to ordinary reality, but also, simultaneously, a change in mental state brought about by the "entering of a spirit," we find ourselves returning to the ambiguity I mentioned at the beginning: what is a human being, in Buryat culture, if the vital experience of "what is there" implies the loss or suppression of the recognized personality?

* * *

The idea that the shaman gives the unconscious (of the patient) a structure was put forward by Lévi-Strauss in 1949 in his two papers, "Le Sorcier et sa Magie," and "L'Efficacité Symbolique,"[10] in which he proposed an analogy between the shaman and the psycho-analyst. Briefly, he argued as follows: "The unconscious ceases to be the haven of individual peculiarities – the repository of a unique history which makes each of us an irreplaceable being. It is reducible to a function – the symbolic function, . . . which is

[7] *Üjemerle-*: the word is formed from the root *üje-* "to see" + the *mar/mer* suffix which corresponds to the English – able/ible, as, for example, in edible from to eat (the Mongolian suffix also implies that the thing is "worth seeing"), + the verbal ending *la/le*.

[8] "Shamanise" – the word used here is *bögele* – from *böge* "shaman;" the text gives *bögeleju bayiju* "being in the state of shamanising," – i.e. to be in a trance. The precise meaning of this will be explained later.

[9] Tugultur Toboyev, *Qori kiged aguyin buriyad nar-un urida-dagan bolugsan anu*, N. N. Poppe, ed. *Letopisi Khorinskikh Buryat*, (Chronicles of the Khori Buryat), Trudy I, V. IX., Leningrad, 1935, p. 19.

[10] First published in *Les Temps Modernes*, No. 41 (1949), and in *Revue de l'Histoire des Religions*, CXXXV, No. 1 (1949). Translated into English by Claire Jacobson in *Structural Anthropology*, New York, 1963, chapters IX and X.

carried out according to the same laws among all men. . . ."[11] The unconscious, he suggested, should be distinguished from the preconscious. "The unconscious imposes structural laws upon inarticulated elements which originate elsewhere – impulses, emotions, representations and memories." These elements, the preconscious, make up the vocabulary which the unconscious transforms into language. The expressions of the unconscious thus correspond to collective (in the case of shamanism) and individual (in the case of psycho-analysis) myths, both of which represent "a quest for the remembrance of things past."[12]

The same idea, that the mechanisms of the unconscious discovered and described by Freud are better thought of as the structures of a language, has been developed in rather different terms by the heterodox structuralist psycho-analyst, Jaques Lacan.[13] He writes, in one of his best known papers, "L'insistance de la lettre dans l'inconscient,"[14]

> "Nous désignons par lettre ce support matériel que le discours concret emprunte au langage.
>
> Cette simple définition suppose que le langage ne se confond pas avec les diverse fonctions somatiques et psychiques qui le desservent chez le sujet parlant.
>
> Pour le raison première que le langage avec sa structure préexiste à l'entrée qu'y fait chaque sujet à un moment de son dévelopment mental."

We are thus the "slaves" of language, – "slaves" also for the reason that the abstractive nature of language, which in fact makes human knowledge possible, amounts to a denial of "reality".

Lacan explains what he means by "reality" in an early paper, "Le stade du miroir comme formateur de la fonction du Je," in which he outlined the theory of the importance of the mirror-stage in the early development of the child, that is, the child's discovery of, and complete fascination with its own image in a mirror. This represents for the child the image of itself as a unified controllable body (je-idéal), by which it anticipates in a mirage the maturation of its strength. This image, which will govern the child's relations with other children, is a rejection of reality, – because for the reality of

[11] Claude Lévi-Strauss, *Structural Anthropology*, p. 202.

[12] op. cit., pp. 203–4.

[13] This idea has also been expressed by other writers, e.g. Erich Fromm. *The Forgotten Language*, 1952, or Tauber and Green, *Prelogical Experience*. *1959*.

[14] Jaques Lacan, *Ecrits*, Paris, 1966, p. 495.

tuted the image of a complete identity, and the reality appears only in dreams and other expressions of the unconscious.[15].

Lacan suggests that just as such a stage in the child seems essential to the development of an ego in the personality, the imposition of specific forms or terms on the diverse variety of what we experience, enabling us to know and control our environment, is a function of language which is essential to intellectual development, – but at the same time, it constitutes a denial of reality.[16]

The psycho-analytic interview, by suppressing normal dialogue – the subject does not talk *to* the analyst, and the analyst does not reply, but rather creates demands in the subject which ensure the repetitive appearance of all the possible permutations of expressions of the neurosis[17] – recovers a language of the unconscious, that is, it makes possible the discovery of "reality."

Using the terminology of the early structural linguists, Lacan describes these expressions as signifiers (signifiant) and the concepts they represent as signifieds (signifié), it being characteristic of the language of the unconscious that the signifier is separated (or "barred") from the signified by the fact that the former has the structure of language, while the latter, at the same time, exists in "la dimension de la vérité."

What does Lacan mean by this? His argument is almost impossible to summarize, surrounded as it is by a dense growth of its own implications, but I give the following points as an indication of the way he thinks. Truth (or reality) is located in that region, which Lacan calls the Other, beyond conscious signification, but at the same time truth is dependent on the fact of language: the dissimulation of an animal – the feint by which the apparent straggler leads a bird of prey away from the fugitive herd – is not a lie, and the question of truth does not arise here because as far as we know

[15] "Ce corps morcelé . . . se montre régulièrement dans les rêves, quand la motion de l'analyse touche à un certain niveau de désintégration agressive de l'individu. Il apparaît alors sous la forme de membres disjoints et de ces organes figurés en exoscopie, qui s'ailent et s'arment pour les persécutions intestines, qu'à jamais a fixées par le peinture le visionnaire Jérôme Bosch, dans leur montée au siècle quinzième au zénith imaginaire de l'homme moderne. Mais cette forme se révèle tangible sur le plan organique lui-même, dans les lignes de fragilisations qui définissent l'anatomie fantasmatique, manifeste dans les symptômes de schize ou de spasme, de l'hystérie."
Lacan, "Le Stade du Miroir," *Ecrits*, p. 97.

[16] This summary cannot do justice to the subtlety of the arguments, see Lacan, "La Direction de la Cure et les Principes de son Pouvoir," *Ecrits*, pp. 585–642.

[17] Lacan, op. cit., pp. 612–9.

animals have no language, or "convention signifiante, comme il se dévoile dans le comique de cette plainte douloureuse du Juif à son compère, 'Pourquoi me dis-tu que tu vas à Cracovie pour que je croie que tu vas à Lvov, quand tu vas vraiment à Cracovie?' "

Truth appears as a distortion of conscious signification, as is shown by the fact (which was scandalous at the time) that Freud discovered it in dreams rather than in conscious thought or morality, and this distortion is brought about by two essentially linguistic structures, metaphor and metonym. Thus Lacan is able to describe the unconscious as a thread of allusions, citations, puns, and equivocations, which, even if they are lies, are guarantees of the truth. "L'inconscient," he writes, "n'est pas le primordial, ni l'instinctuel, et d'élémentaire il ne connaît que les éléments du signifiant."[18]

One of the more direct passages of "L'instance de la lettre dans l'inconscient" summarizes that element of Freud's work which inspired Lacan:

> "Certes, la lettre tue, dit-on, quand l'esprit vivifie. Nous n'en disconvenons pas, ayant eu à saluer quelque part ici une noble victime de l'erreur de chercher dans la lettre, mais nous demandons aussi comment sans la lettre l'esprit vivrait. Les prétentions de l'esprit pourtant demeureraient irréductibles, si la lettre n'avait fait le preuve qu'elle produit tous ses effets de vérité dans l'homme, sans que l'esprit ait le moins du monde à s'en mêler."[19]

* * *

Since Lacan's theory is based on the fact of language, it should apply equally in all human societies, and therefore it should be possible to propose that the "truth" (or "reality") which the European neurotic has come to lose sight of, and needs to recover, can be compared with the "further reality" of the spirit world experienced by the Buryats in dreams and trances, – in the sense that these are both theories, from different cultures, about a single aspect of human life.

I am proposing, in other words, that the "spirits" which the Buryats understand to exist in the further reality may in some way represent experiences which are denied or fragmented in ordinary language, – that is, in conscious life.

The manifestations of spirits are made up of signs, which use the distortions of metaphor and metonymy in order to be able to

[18] Jaques Lacan, L'instance de la lettre dans l'inconscient, *Ecrits*, p. 522.

[19] Lacan, op cit., p. 509.

tell the truth. Like the unconscious, the "spirits" of the Buryat are present in everyday life, but they cannot be realized or seen. I have already said that various devices are used to discover the location of spirits in animals and objects; we can now see that these habitations are signs, telling us about particular spirits. This kind of manifestation of spirits is greatly elaborated in the case when spirits inhabit human beings who are unconscious of their presence: based on a classification of symptoms (physical or psychological) the Buryat make hypotheses about the disorders which affect people. These hypotheses are in fact "spirits," each of which consists of particular symptoms: itchy scabs and rashes are the symptoms of Friend Snow-Leopard spirit, tooth-ache and swellings of the gums are caused by the presence of the spirits of the ermine and yellow weasel, and so on.[20] The symptoms can be seen initially as signifiers produced in the unconscious of individuals (I am referring here primarily to "psychosomatic" symptoms) in respect of certain experiences of reality which have been suppressed. When these symptoms are allocated to a spirit (this is usually done by a shaman but sometimes the patient himself is able to make the connection), they have already been interpreted or analyzed.

Lacan sees this as the operation of the metaphor:[21] "Le méchanisme à double détente de la métaphore est celui-là même où se détermine le symptôme au sense analytique. Entre le signifiant énigmatique du trauma sexuel et le terme â quoi il vient se substituer dans une chaîne signifiante actuelle, passe l'étincelle, qui fixe dans un symptôme, métaphore où la chair ou bien la fonction sont prises comme élément signifiant, la signification inaccessible au sujet conscient où il peut se résoudre."

The "spirits" thus make themselves felt in Buryat life by various abnormalities. But it is not the case that all illnesses, strange behaviour, or misfortunes are attributed to spirits – they may be caused by "bad luck," pollution, or the absence of any one of the three human souls.

"Spirits" can act in several different ways: they may cause misfortune from a distance without entering the body, they may steal away a soul, they may enter the body and master the souls, or they may trouble the "mind soul" alone, leaving the body untouched. This latter case is what we know as "spirit possession," – i.e. the spirit makes use of the healthy body and voice of the subject

[20] B. E. Petri. *Vnutri rodovye otnosheniya u severnykh buryat* (Intra-lineage relations among the Northern Buryat), Irkutsk, 1925.

[21] Lacan, *Ecrits*, p. 518.

in order to make its wishes known. This case is the most informative for us, since here the subject is not ill or delirious, and the "spirit" is freely expressive in words and gestures.[22]

But, as we might predict, since not all psychic effects, which are unconscious in the sense of excluding the characteristic of consciousness, have any relation to the unconscious in the Freudian sense, it is also the case that not all abnormal functioning of consciousness is attributed by the Buryat to spirits.

Lack of material makes it impossible to analyze the whole spectrum of mental disorders among the Buryat, but we do however know of two fairly well documented examples of illnesses, both of them entailing a loss of normal consciousness, one of which is thought to be due to spirit possession, and the other of which has nothing to do with spirits at all.

Let us look at the second of these two. This is the mental disorder called *beleng*, sometimes translated as "jumping disease," which appears to be very similar to the Malayan *latah*. The illness consists, in the Mongol case, of (1) a startle reaction, in which the subject shows a violent reaction to being mildly frightened – he may go rigid, or flee, or revert to coprolalia (shouted obscenities) or try to destroy the source of his surprise – and (2) an imitation reaction, in which the subject involuntarily and mechanically imitates the actions and words of the person or thing which frightened him. In most subjects it is the fact of being startled which brings on the imitative reaction, and the likelihood of this happening is increased with the intensity of the social situation. Often a situation of powerlessness of the subject brings on an attack, as, for example, when a person is set upon and tickled, and this may also apply to groups of people; once when a Russian colonel was drilling a troop of mixed Buryat and Tungus Cossacks he was infuriated to find that instead of obeying his orders they were repeating the words after him, and the more he swore at them, the livelier was the chorus of Cossacks imitating his curses. The soldiers did not intend to be disobedient, but on the contrary were especially impressed by the occasion and overawed by the Russian colonel who was unfamiliar to them.[23]

A classic case is reported by Aberle from the Khalkha Mongols. The man was known to be very ticklish and people teased him by tickling him. The tendency to imitate words or actions was very

[22] P. P. Batorov. *Materialy po narodnoi meditsine alarskikh buryat* (Materials on the folk medicine of the Alar Buryat), Buryatovedcheskii Sbornik, I, Irkutsk, 1926.

[23] S. M. Shirokogoroff, op. cit., 251–2.

developed and could be provoked by startling him or joking with him. He could be made to drink until he vomited, imitating someone who pretended to drink. Once, slightly drunk, he tried to mount a jumpy horse, which started to buck. He grabbed the horse's ear, and when people heard the commotion and ran out, they found him holding the ear and jumping frantically along with, and in imitation of, the horse. He could not stop until he was caught and pulled away, and then he was deeply grateful. Easily startled, he shouted obscenities, regardless of the situation. Once, during the consecration of a young Living Buddha, aged four or five, the little boy moved from a sitting to a squatting position. The *belengchi*, rightly assuming that this was a preliminary to urination and began to shout, "Oh, oh, he's going to urinate!" using an obscene epithet for the Living Buddha, one which Aberle's interpreter could not translate.[24]

Two other cases from the Khalkha Mongols: a lama tipped over a skin bottle bull of fermented milk, wanted passionately to right it, but instead had an irresistable impulse to imitate the sound of the milk running out, until it was all gone. An old lady, who had taken religious vows, swayed to and fro for a long time, imitating the fluttering of a weed with a tuft of camel's hair caught in it, unable to stop until someone came among and removed the wool.

This behaviour pattern is common all over Siberia, (it has been learnt by Russians from the native peoples), and it is nowhere thought to be due to spirits. Rather, it is explained as a "bad habit" of people who are easily frightened and made helpless. The attack itself is not considered frightening or abnormal, but a ludicrous overemphasis of a reaction which anyone might have (i.e. the tendency to do something forbidden in tense social situations), and the "bad habit" is simply that of losing control. Since the form the attack takes is dependent on an outside object (the thing, word, gesture, etc., which is copied), *beleng* is seen as a loss of personality in a given situation, rather than the intrusion of an abnormal personality. The fact that anyone, from any culture, may become *belengchi* and have the same symptoms, confirms this view.[25]

[24] D. F. Aberle, "Arctic Hysteria" and Latah in Mongolia, Trans. N.Y. Academy of Sciences, series II, vol. 14, No. 7, pp. 291–297. The disorder is also common among the Buryats, but not so well documented. S. I. Mitskyevich, *Menerik i emiryachenye, formy isterii v Kolymskom krae* (*Menerik and Emiryachen, forms of hysteria in Kolymsk region*), Mater. komissii po izuch. Yak'utsk. ASSR, vyp. 15, Leningrad, 1929.

[25] In my opinion the *beleng* attack may be connected among the Buryats with the idea of the loss through fright of the mind soul, leaving the body without direction, and at the mercy of events. Fright is capable of

Beleng is not associated with spirits. Now let us look at the mental disorder which the Buryats hold to be due to the "possession" by spirits of the mind, *zayagalkhu*.[26] This is a form of hysteria which attacks both individuals and groups. Among the Buryat the phenomenon of mass hysteria is very common and has been described by several authors, but individual hysterical attacks, although they occur, have not attracted the attention of capable ethnographers as a phenomenon in themselves. Therefore I give here the account of the same disorder among the Tungus, described by the psychologist S. M. Shirokogoroff. (Shirokogoroff lived for many years among several groups of Tungus and Manchus and had the opportunity to investigate the whole range of mental disorders and their treatment.) As will later become clear, the Tungus form of hysteria is virtually identical with the Buryat.

"The hysterical person," writes Shirokogoroff, "knows from the observation of similar cases and hearsay that the person must perform certain acts. These acts are, for instance, the singing of certain tunes (*rhythmed*), the uttering of certain words (in a particular language), covering the face with hair, and so on. In such a state, the person may completely relax, weep, and loudly express himself (within a certain limit) either directly or as a *porte parole* of the spirit. As a matter of fact the spirits usually express things which cannot be expressed before the seniors or before the children, and the most secret desires may be expressed without any personal consequence, e.g. a young person holding a spirit may require personal attention to herself or himself in the form of a sacrifice, prayers, etc.; he or she may express sexual desire with indication of the person desired, which can be done directly, or in symbols, without being blamed for it.

". . . Such a fit is not likely to occur when the person is alone, or when there is no-body to observe (e.g. only small children, or very old people), and no neighbours are near by. Still less is the chance of this occurrence during travelling or in any other responsible

causing illness: *ebedchin-ü tula üjebesü . . . siltagan inu . . . aci-tu modun-i ogtagulsan esebesu elcil ügei gazar-a yabuqui-dur sedkil inu ayiju ese amurligsan-aca bolba*: "If sickness is being investigated, the cause is . . . that he cut down beneficial trees or that, going into a deserted place, his mind became troubled through fear, and it happened because of this." (Bawden, op. cit., p. 160.)

[26] Modern form *zayaalkhu*, literally "to cause to *zayan*;" the word *zayan* has been explained above (note I). The causative is used as it were in anticipation of the spreading of the hysteria to other people (A. D. Rudnyev, *Melodii mongol'skikh plemen* (Melodies of the Mongolian tribes), Zapiski po otd. etnogr. IRGO, tom XXXIV, St. Petersburg, 1909).

or difficult situation, advanced pregnancy, various conditions which keep the mind busy with other worries, or social gatherings which require particular attention."[27]

The most remarkable fact about these hysterical seizures is their uniformity, despite the apparently delirious state of the subject. Shirokogoroff writes, "The forms are repeated in the same sequence by hundreds of people affected."

"The most common forms, which may occur separately or in sequence, are: ... (1) hiding from the light, closing the eyes, covering the face with hair; (2) crying and singing; (3) lying on the ground or bed; (4) running away into the forest; (5) hiding in rocks; (6) climbing on trees; (7) thrusting oneself between trees and branches. These methods are repeated from generation to generation, transmitted by tradition, and there can be little change in the performance, for the person might be suspected of not being affected by such and such a spirit."

"Possession" by spirits occurs not only during waking hours as a semi-conscious hysterical attack, but also during sleep in the form of crying, singing, covering the face with hair, sleep-walking, etc. – the two conditions are not differentiated by the Tungus.

In neither state does the subject usually remember what he has said during the attack; this is shown by the fact that during the "possession" people are observed to speak languages which they cannot speak in normal conscious life.

According to Shirokogoroff, the Tungus are "positively convinced that a special language is needed" for the spirits. Some of the spirits do know the Tungus language, but this is not everyday language which people speak to one another: it contains "a certain number of petrified expressions and words no more used in the current speech, for fear that the spirits cannot understand new words, – and a great number of alien words, expressions, and even formulas, which have been borrowed as a special language good for spirits. . . . In addition it may be indicated that the Tungus use a certain number of suffixes, doublets, etc., which are used for making prayers more rhythmic and 'nice,' also at the same time different from the common speech." "In consequence, the prayers sometimes cannot be understood at all even by those who make them and still less by the investigatiors" (i.e. the audience).[28]

Very often the spirits, rather than speaking Tungus, use an existing

[27] Shirokogoroff, op. cit., p. 254.

[28] S. M. Shirokogoroff, op. cit., p. 205. (Shirokogoroff's English is a little stilted, but I prefer to quote his own words as written.)

foreign language, e.g. Buryat, Russian, Manchu, or Chinese, and it is a fact that people who do not speak these languages, can speak them in their sleep when "possessed." Shirokogoroff writes: ". . . the Tungus marvellously quickly learn languages, but there are inhibitory conditions, namely, the interethical relations and the relative shyness of the Tungus, they do not want to offend the hearer's ear by speaking badly, and they believe that they cannot learn a foreign language, just as foreigners cannot learn the Tungus language. However, since the Tungus meet with foreigners and listen to them, they unconsciously learn their language, but very often believe that they cannot speak. In the state where the *logical thinking is in force*, they cannot speak, but as soon as the 'logical' (adopted and approved by the ethnical group) way of thinking is eliminated, they can speak. Such an elimination occurs at the time of sleep . . . and in hysteria."[29]

* * *

This account makes it clear that hysterical attacks (*zayagalkhu*), whether they occur during sleep or when awake, are very different from *beleng*. These differences should enable us to find out what it is, in abnormal mental states, that denotes the presence of a "spirit."

Firstly, hysteria starts without an initial external stimulus. Far from occurring in tense social situations, like *beleng*, it tends to happen when the subject is not under strain from external events, and is able to pay attention to his own inner feelings. During the attack, the hysterical subject does not express himself in impersonal imitations, inspired by some external object, but instead he discloses something which is recognized (even if it is disguised) to be a personal revelation. The one disorder brings about an abnormal annihilation of the individual personality, the other constitutes a sudden expression of aspects of the individual self which are normally hidden.

Secondly, as the Tungus material indicates, these very hysterical attacks, when social conventions are disregarded, and people apparently "let themselves go," and literally "let their hair down," are at the same time formal, not varied by individuals, and repeated in the same way from generation to generation; even the language spoken by, and to, the spirit is a special ritual language with its own unvarying formulas, or else a foreign language not normally understood by the subject. This contradiction does not exist at all in *beleng*. Because the manifestation of the attack (that is, the words

[29] S. M. Shirokogoroff, op. cit., pp. 256–7.

and actions of the subject) depends on the "accident" of whatever happened to startle the *belengchi*, there can be no cultural or linguistic patterns as in hysteria, but only mechanical inscrutable repetitions, as of the plant waving in the wind, or the milk running out of the bottle.

Thus it appears that there are two criteria for the presence of "spirits": (1) an element of personal revelation, and (2) a "language" of behaviour and speech in which to express this revelation. It is not difficult to see that the concept of "spirits" in this sense is used by the Buryat as a model within the general mental phenomenon which Freud and Lacan call the unconscious.

But there are important differences between the European and the Buryat concepts. If the characteristic of the unconscious (and also of "spirits") is that it is composed of signs, then why do the Buryats not recognize that the acts of *belengchi* are signs – which, according to Freudian theory, they must be without doubt? Buryat, Mongolian and Tungus material makes it clear that *beleng* is one of a class of mental disorders, all of which have the characteristic of not being connected with "spirits"; these are, phobias (it is common for *belengchi* to have phobic reactions to snakes, frogs, spiders, etc.),[30] obsessive behaviour, echolalia (repetition of the last word of the speaker), coprolalia (impulsive enumeration of forbidden words), and stuttering. Rosenzweig's experiments on defence mechanisms have shown that in European culture too there is a positive correlation between obsessive behaviour, non-hypnotizability, and stuttering, which is opposed to the traits of hysteria, dissociability, and repression, whose close relationship was established by French psychopathology;[31] be this as it may, the disorders which Buryat culture links together do have one characteristic in common: the manifestation of the disorder consists of *repetitions*, which cannot in themselves signify much to people outside, but which on the other hand, either because of the timing of their occurrence or their intrinsic associations, are deeply significant to the subject. In other words, the sign of the *belengchi* is a sign only to himself. It exists in the dimension through time of a single life (organized, it is true, by atemporal structures), and occurs and recurs in response to the emotional needs of an individual. This is why, in spite of the very common occurrence of *beleng* among individuals of the Tungus,

[30] D. F. Aberle, op. cit., pp. 291–7.

[31] Saul Rosenzweig, *The Experimental Study of Repression*, reprinted in *Freud and Psychology*, ed. S. G. N. Lee and Martin Herbert, London, 1970, pp. 198–200.

mass *beleng* is very rare (the incident of the soldiers and the Russian colonel is the only case known to me), and, according to Aberle, does not occur at all among the Mongols.

But, as we saw, a disorder of the hysterical type, that is unconscious behaviour associated with the "spirits," never occurs when people are alone, and in perhaps the majority of cases it spreads from one person to another, often reaching the proportions of mass hysteria. Some kind of communication with other people is clearly necessary in hysteria, and this must take place by means of the "language" of the spirits described above.

What do we know about this "language"? It is actually different from everyday language; it is a phenomenon of altered states of consciousness and is normally not remembered or understood in ordinary life; it is a means of communication between people of one society. The first two characteristics bear out the theory of Lacan, i.e. they confirm that for the unconscious to be expressed it is not enough simply not to be conscious, the language of expression itself has to be different – and they apply equally to the compulsive actions of the *belengchi*, the formalized ravings of the possessed, and the dreams of the European. (There is no difference at this level between what we should call neurotic and non-neurotic people; – indeed it is unlikely that the Buryat would regard either the *belengchi* or the hysteric as abnormal.) It is the third characteristic of "spirit language which differentiates the North Asian phenomenon from a European equivalent: the possibility of communication in this language demonstrates the existence of an inconscious of society, or rather of a level of thought in society which operates through the unconscious of individuals. It was perhaps the lack of this faculty in our society which Lévi-Strauss was referring to when he wrote: "For the myth *form* takes precedence over the *content* of a narrative. This is, at any rate, what the analysis of a native text seems to have taught us. But also from another perspective, we know that any myth represents a quest for the remembrance of things past. . . . Psychoanalysis thus derives its specific characteristics from the fact that in industrial civilization there is no longer any room for mythical time, except within man himself."[32] In other words, in our society we usually have the kind of mental illnesses which the Buryats would class as not associated with "spirits."[33]

[32] C. Lévi-Strauss, op. cit., p. 204.

[33] I do not mean to imply here that we have no social thought on an unconscious level at all (see E. R. Leach, "Anthropological Aspects of Language: Animal Categories and Verbal Abuse". *New Directions in the Study*

The Buryats evaluate the two kinds of illness differently. The *belengchi* is simply a person with a "bad habit;" but the man who is regularly possessed by a spirit has the possibility of knowing it and mastering it. Such a person may in time become an *üzemerchi*, one who can enter the spirit world at will and "see what there is to be seen."[34] Various people in society may be *üzemerchi*: – smiths, magicians, singers, fire-makers, musicians, and anyone who specializes in ritual – but without doubt, the *üzemerchi* par excellence is the shaman or shamaness.

Raymond Firth's definitions are clear and to the point here. The Buryat or Tungus hysteric is subject to *spirit possession* in Firth's terms; but there are also many people in Buryat society who are *spirit mediums*, i.e. they are "conceived as serving as an intermediary between spirits and men. The accent here is on communication; the actions and words of the medium must be translatable, which differentiates them from mere spirit possession." Then there is the *shaman*, who is normally himself a spirit medium, but primarily is a "master of spirits," – i.e. "he is thought to control spirits by ritual techniques."[35] My point is that, in Buryat society, these three roles operate in a continuum: it is not possible to become a shaman without having previously been a hysteric and a spirit medium, and if a shaman loses control, he is liable at any moment to slip back into the role merely of spirit medium and even into that of the more or less unintelligible hysteric.

[*To be continued.*]

of Language, M.I.T. Press, 1964; see also, Vieda Skultans, "The Healing Process" (a study of Swansea spirtualists), *New Society*, 10 June, 1971 but only that it is not comprehensive, nor formalized, on the scale of the Buryat.

[34] The high value placed on "seeing" is quite explicit. Potanin gives a Khalkha Mongol story of the man who had three sons whom he wanted to learn the "three miraculous powers" (*gurban erdeni*): the eldest son went to the East and learnt divination and fast movement; the middle son went to the South and learnt magic and turning one thing into another (*khubilga-*); the youngest son went West and found out how to hear and see what goes on in the sky and on the earth. The youngest son and the West are, of course, the most valuable in Mongol culture. (Potanin, *Ocherki Severo-Zapadnoi Mongolii* (Sketches of N.W. Mongolia), vyp. 4, St. Petersburg, 1883, p. 531).

[35] R. Firth. *Essays on Social Organization and Values*, ch. X, "Problem and Assumption in an Anthropological Study of Religion, pp. 247–8, London, 1964.

Industry in Historic Towns

Lewis Braithwaite

In recent years there has been widespread interest in conservation and the quality of our urban environment, and particularly in the problems of our historic towns. In 1965 the Council for British Archaeology, after considering 660 places "possessing some urban quality and recorded antiquity", listed 324 "historic town centres worthy of preservation", 232 in England, 35 in Wales and 57 in Scotland; in 1967 the Civic Amenities Act made it possible to designate "Conservation Areas"; there are now (August 1971) 820 Civic Societies affiliated to the Civic Trust; and the Government commissioned the Four Town Reports on York, Chester, Bath and Chichester, followed in May 1970 by its Preservation Policy Group Report.

The familiar approach to Conservation is that pioneered by Gordon Cullen which analyses the architectural and "townscape" character of a town and show how this can so easily be wrecked: by piecemeal road-widening and splaying-off corners (to help the flow of traffic which shouldn't be there at all), by gaps in street frontages (often occupied by parked cars) and insensitive "in-fill", and by huge, hard, horizontal shop facades blatant in scale and materials. But a visual approach is not enough in itself; appropriate *activities* for these buildings and streets must be ensured and an attractive urban environment created where the visual qualities can be enjoyed; a hierarchy of urban roads must be organized, on the Buchanan model, and unnecessary road traffic removed; *some* land-uses must be limited – such as the huge food supermarkets which, besides being particularly intrusive visually, generate considerable road traffic both to service them and for customers to take the heavy goods away; and *others* must be encouraged, such as people living in the town centre, some perhaps in the empty upper floors above shops, or any specialist shops and offices prepared to accept the limitations of operating in a historic building in return for the advantages of being in a historic town and a tourist centre. And having buildings of various ages not only leads to attractive aesthetic qualities in a town, but to a wide range of shops and service trades and a mixture of social classes in its residents which many people also find attractive. In Bermondsey I witnessed the replacement of a group of local shops during "redevelopment" by the only activities able to pay the new rents – a bank, a dry-cleaner and a betting shop; and I live in the historic town of Leamington, which besides, being almost the only town of any visual quality in the Midlands, has a wider range of shops than either central Birmingham or Coventry, and a wider range of people living there than in working-class Coventry or middle-class Solihull.

Even controlling the activities in the town centre is not enough if the town is not economically viable. Imagine a small country market town, as most historic towns are, 20 miles or so from the next town, and draw round the town the boundary of the town's shopping catchment area and rural hinterland, say, a circle of 10–12 miles radius. Any goods and services that are exported across this boundary, and any money coming in, are *primary* economic activities earning money for the area, but goods, services and money circulating within the area are *secondary* economic activities dependent on the *primary* activities bringing money into the area to be spent. Common primary economic activities for such a town would be exporting agricultural produce or minerals, manufacturing industries with a national market, people living in the town who commute across the boundary to earn their living outside, people who, having made their money elsewhere, choose the town to retire to, and tourist visitors from other regions and other countries who spend money there. Of these sources of income, manufacturing industry is in many ways the most satisfactory; for it provides well-paid employment all the year round for people of all ages and classes (preventing the town from becoming exclusively middle-class or full of old people), and it brings in intelligent and articulate professional men who often form the driving force of the local Civic Trust, and perhaps even live in a historic house themselves. The *secondary* economic activities are most forms of shopping (a possible exception being certain specialist shops of regional significance or related to the tourist trade), the local lawyer, doctor, etc., or even small industries, like the local building contractor or precast concrete yard or garage and agricultural repair shop which only operate within the area.

Unfortunately this distinction does not seem to have been grasped by many borough councils who seem obsessed with expanding their *shopping* as a panacea to guarantee the prosperity of the town. In December 1966 it was estimated that "if all the town centre schemes before the Ministry for approval (presumably in England and Wales) were implemented, there would be sufficient shopping facilities for a population of 164 million."[1] The town councils overestimate their shopping catchment population, pull down the central streets for new supermarkets and car parks, only to find, too late, that they cannot let all the new shops, and that all that has been achieved is to wreck the visual character of the town; the council would often have done better, purely on economic grounds, to have made their town an attractive place to *live* in.

It was therefore decided to investigate the fundamental economic basis for these towns, by looking at their *industry* – "industry" in this sense meaning any primary economic activity exporting goods across the boundary and includes any service industry, such as an industrial consultant, selling know-how outside the area, but not the shops, professional people and industries that only serve the immediate area. Having made this distinction, what "industry" do historic towns have, and is the historic character of a town an asset in any way to the firms operating there; for example does it affect the firm's recruitment of labour, transport costs or ability to keep its work people and staff? The country towns of the North-Eastern United States are full of booming light industries; is this a pattern we are beginning to follow in this country, and if so does a firm's location depend on any environmental factors?

By studying a group of country towns from all over the country one is in effect questioning major assumptions of industrial location theory and planning policy: namely that for a town to be prosperous industrially it must not only be large but must *grow;* and that location decisions are based solely on economic factors, such as the nearness of raw material and the cost of transport.

As it happened most "industry" was located in new industrial estates on the outskirts of the towns and the project had little directly to do with the problems of the central area. However, despite some popular prejudice, there is no inherent conflict between a town being conserved and it having industry – on the contrary some industry is necessary for conservation. The new specialist "neotechnic" engineering industries (to use the term coined by Patrick Geddes) are small scale – employ fairly small numbers and rely on electric power and have none of the visual massiveness, heavy lorry traffic and fumes or air pollution of the traditional heavy "paleotechnic" industries of the 19th century. And even in the central area certain industries that do not require elaborate loading facilities or a lot of space can often operate happily without detri-

[1] C. Darlow: Shops and Shopping Districts. "The Estates Gazette". 17th Dec. 1966.

ment to the historic character and even value it as a working environment. Birmingham has an interesting example of conservation by industry; in striking contrast to the conscious destruction by the City since the war of all its 18th century houses (such as Temple Row – 8 fine Grade II early 18th century houses demolished to make way for Birmingham's largest new store) the jewellery firms operating in their original historic premises in St. Paul's Square vigorously opposed their "redevelopment" into faceless new flatted factories, with the result that this square is shortly to become Birmingham's first central Conservation Area.

METHOD

The research study lasted for the academic year 1968-69 and was supported by the Frederick Soddy Trust at the University of Sussex.[2] After a preliminary classification to select a representative sample, 19 historic towns were visited; and it is the interviews with firms in these towns and letters written by them that form the basic raw material of the study.

A table of the 19 towns visited is given below. In order to select them, data was collected for a Preliminary List of historic towns consisting of the 267 settlements on the CBA List in England and Wales whittled down to 36 towns with a population of over 15,000 in 1966 and 104 under; 6 Victorian historic towns, like Barrow-in-Furness and Llandudno, were excluded and then 28 Georgian and Regency towns, like Penrith, Cheltenham, Sidmouth, Mansfield, Leamington and Brighton; and then, at one end of the scale, places administratively only parishes today, like Chipping Campden and Thaxted; and, at the other, the larger historic towns (over 45,000 in 1961): Cambridge, Chester, Carlisle, Exeter, Colchester, Gloucester, Southampton, St. Albans, Peterborough, Rochester, Lancaster, Lincoln, Yarmouth, Norwich, Newcastle-upon-Tyne, Nottingham, Oxford, Shrewsbury, Bath, Ipswich, Richmond (Surrey), Worcester, York. These larger towns are undeniably historic towns, but it was felt that they could not be considered as a group, as special factors had to be considered to account for their survival, and many of them (especially the County Boroughs which unfortunately control their own planning) have recently largely destroyed the unity of character or cohesion they once had. In

[2] Copies of the full research report (133 pages incl. appendices) are lodged in the Library of the Department of the Environment, Whitehall, London, S.W.1 (formerly the Library of the Ministry of Housing and Local Government) and in the Library of the University of Sussex.

any case the most obvious single fact about the places on the CBA List is that in general they are small – because if a place grew too much, it destroyed its historic character by doing so. As a recent paper puts it: [3] "Of the 27 English towns (excluding London) which had a population in 1801 of more than 12,000, almost without exception the only ones which have survived to be classified by the Council for British Archaeology are those which have subsequently grown the least."

The classification of the Preliminary List towns was done, following Moser and Scott,[4] according to variables of Age Structure (made the primary variable to pick out "working towns" from "retirement towns"), and Social Class and postwar Growth. Towns were selected over a range of Age Structure, and from different parts of the country, and classified as "medium", "high" or "low" in the secondary variables of Social Class and Growth, according to whether they were more than one Standard Deviation above or below the Mean. The top half of each group on the table were towns with "medium" Social Class and Growth; but the other half were abnormally "high" or "low" in any or all of these three variables. These abnormal towns were not excluded from selection, because it was hoped that contrasting extremes, such as Cowbridge and Southwold, might lead to sharp differences in their industry and character; and it is also likely that the future pattern of those historic towns that survive (and indeed the probable reason for their survival) will be as small low-growth towns of high Social Class.

Though time-consuming and of some interest in itself, the classification and selection shouldn't be taken too seriously; the statistical information is sometimes unreliable because based on very small numbers, often out of date, and depends on how closely the borough boundaries are drawn round the urban area (Southwold for example has its modern council housing "over the water" in the parish of Reydon). And how legitimate is it to consider a town without its rural hinterland where many of the people who work in it live? Even if the data is considered valid, all that was attempted was to select towns with a range of demographic characteristics, not with a range of types of industry; for industrial information is not available, either for the same local government areas or for such small towns. Still it is hoped that a range of towns was selected that were not just the author's personal favourites, and that some generalizations can be

[3] David Smith in his prize-winning essay on historic towns for the 1967 Town and Country Planning Summer School.

[4] *British Towns* (Oliver and Boyd, 1961).

attempted for the group – which can as well be regarded, rather than "historic towns", as "unspoilt, small country market towns" – a town's presence on the CBA List defining "unspoilt".

THE 19 TOWNS SELECTED TO VISIT

FROM THE 36 LARGER TOWNS

	Age Structure		*Social Class*		*Growth*		*1961 pop.*
Durham City	22.0	1st	19.9		124.0		20,514
Warwick	20.5		16.9		166.6		16,051
Winchester	18.9		18.4		119.2		28,770
Chichester	17.1		19.1		114.8		20,124
East Grinstead	17.8		28.8	H 1st	175.0		15,448
Newark	18.9		11.0	L 33rd	118.8		24,651
Scarborough	14.4	35th	17.1		83.2	L 34th	43,061
Means	19.06		16.73		139.7		

Age Structure: % of total population of Males 15-44 – 1966 Sample Census.
Social Class: % of total males, occupied and retired aged 15 or over, in Socio-Economic Groups 1, 2, 3, 4 & 13 – 1966 Sample Census.
Growth: New Housing Rate 1945-1966 per 1,000 1961 population (MOHLG data).

FROM THE 104 SMALLER TOWNS

	Age Structure		*Social Class*		*Growth*		*1961 pop.*
Thame	20.1		23.2		179.0		4,207
Brecon	19.3		17.5		94.0		5,766
Wells (Somerset)	18.4		23.9		162.0		6,715
Sherborne	17.8		22.2		103.6		6,053
Sudbury	16.8		21.0		163.2		6,642
Totnes	15.6		22.3		89.3		5,502
Cowbridge	21.8	2nd	27.1	H 11th	62.8	L 101st	1,067
Southwold	10.9	104th	34.5	H 1st	79.7	L 96th	2,234
Wilton	21.4	3rd	12.1	L 104th	132.9		3,402
Faversham	17.7		14.6	L 101st	123.8		12,984
Tewkesbury	19.4		17.6		247.0	H 5th	5,822
Barnard Castle	17.6		24.6		32.6	L 104th	4,968
Means	18.21		21.1		137.0		

Age Structure: % of total population of Males 15-44 – 1961 Census.
Social Class: % of total males, occupied and retired aged 15 or over in Social Classes I and II – 1951 Census.
Growth: From the same source as for the 36 larger towns above.

An average of three days was spent in each town. The Town Clerk's office was visited to get local background (very useful), the county planning offices to find out the policies on conservation and growth (less useful, because too early after the Civic Amenities Act for anything to have been finalized), but the one local Employment Exchange visited proved so unintelligent and uncommunicative that no others were contacted. Having located the industries, it was found best to visit their premises without warning; it was difficult to explain one's purpose over the phone and once convinced one wasn't a travelling salesman the firms were usually helpful, sometimes perhaps from a natural courtesy but often from a genuine interest in the project. When there was no one available who knew the relevant facts an appointment was made later. Sometimes one had to, or was told to, write, and although about a third elicited no reply, the letters form a useful supplement to the notes of the interviews as well as being more considered answers.

THE VISITS TO THE TOWNS

The industries in two of the larger towns, Newark and Warwick, seemed little affected by their town's historic character.

Newark had a lot of engineering, the biggest firms being Ransome and Marles, ball-bearings, 4,000 employees, and Worthington-Simpson, pumps, 1,400 employees, both of which moved from London in the 1900s; and there was also a brewery, three small clothing firms using female labour, and firms using the Trent Valley concrete aggregates. However a newly-established communications consultant in offices just behind Newark's famous market place, after describing the advantages of being half-way up industrial Britain on main road and rail routes with relatively cheap property said: "We all enjoy working in the centre of Newark and most of us appreciate the picturesque nature of the town . . . but lamentably business and pleasure rarely mix. We are often remembered because of our situation as well as our work, but the present premises are fast becoming a worrying handicap to our business. The other advantages are the comparative peace of a small town which provides an excellent atmosphere for deep thinkers, which we must be, and the ease with which one may select a parking place for one's car."

Similarly Warwick was packed with engineering industries, ranging from Pottertons, boilers and central heating, 1,300 employees, Benfords, concrete mixers, etc., 600 employees, Turriffs, civil engineering contractors, to a number of firms sub-contracting for the motor car or machine tool industries of Coventry and the Midlands. An unusual success story was a factory making 130,000 pies a week which started from the managing director's wife making home-made pies in a canalside pub in 1961; and a plastics mouldings firm had a nice symmetry in its labour force – white women at day, Indians and Pakistanis at night. Many firms thought Warwick ideal to operate in, as a small town near a conurbation with a large population and a sophisticated engineering infrastructure, but the only person to mention Warwick's historic character was an industrial designer in an old mill building, who said snotty Londoners have heard of Warwick and think it a good place for a designer to be, whereas if one set up in, say, Rugby, everyone would assume you were just a local man.

Many firms mentioned Warwick's position near the centre of the country as an asset, and it is the geographical position of Thame, between the Midlands and London and the South, that accounts for it being used as a major distribution centre – by George Angus, fire-fighting equipment, Shell-B.P. and British Oxygen, though there are also several "London fringe" engineering firms, moved out from the High Wycombe area.

The position is somewhat different in the North-Eastern Development Area; for here there are few specialist engineering firms and the need to provide new jobs with the decline of the traditional industries of mining and shipbuilding.

Durham City has just had the P.O. Saving Certificate Office transferred from London to provide jobs for girl secondary school leavers, a London clothing firm has come up to tap the less educated female labour; and Mono Containers, moved since the war, spoke of "the good quality labour supply" and its acceptance of shift working. Near the by-pass was a branch of the John Thompson Group, making motor tankers, and a wholesale grocers: and in the town were two "historic" industries, a carpet manufacturer originally founded to provide "woollen manufacturing for to set the poor of the county at work", and an organ builder deriving some custom from ex-graduates of the theological college.

Scarborough does not share the hard-core N.E. problem, being away from the mining and shipbuilding area and with high unemployment only in the winter, people often leaving other jobs to work in the summer tourist trade. Some firms originated from the agricultural hinterland, making poultry cages, standby electrical generators for farmers, silo machinery; and a Canadian deep-frozen potato chip factory using local potatoes, saves on its effluent disposal by being near the sea and runs down its labour force (mostly women) in the summer to only 40% by doing peas. The biggest firm, employing 900, makes luxury motor coaches, but found Scarborough isolated and short of skilled labour; but a switchgear firm, dispersed from Leeds during the war, found Scarborough's resort character attractive to older engineers intending to retire there. Another firm proclaiming in its brochure "our works are situated amid flower beds and green lawns in rural Yorkshire . . . the smoke-free, sea-fresh air refreshes the mind, aids tip-top thinking", had 35 replies for the job of Works Manager and 50 for Accountant. And there were three of the familiar small clothing firms tapping the female labour, two based in Leeds, one with units also at Pickering and Malton.

The low-growth moorland town of Barnard Castle seemed contented enough as a market and residential town, for retired farmers and commuters to Darlington; but nevertheless it has a large pharmaceutical firm employing 900, put there in 1945 by the Board of Trade because of labour available, clean air and no danger from air-raids. A small glove firm moved to an old carpet factory between the wars to tap female labour, and a firm established in 1832 now makes road equipment for a national market. The pharmaceutical firm was increasingly using Barnard Castle for packing and distribution and no-one found it remote, just off the A.1 and the A.66 to Carlisle; the MD of the road firm had a house in the Lake District and a friend who came up to work with him from Warwick "to be in the country".

Two similar country market towns were Brecon, like Barnard Castle in a Development Area, and Cowbridge, 12 miles W. of Cardiff. Cowbridge has only one industry, a printer, started there in 1769; the main railway line went through Bridgend instead; but now Cowbridge is becoming a commuter town for people working in Cardiff, at Aberthawe power station and the new Royal Mint at Llantrisant. At Brecon the biggest employer is the County Council but it is also the army HQ in Wales and centre of a national park. On an industrial estate outside several firms have set up new factories – engineering from Birmingham, clothing from Worcester and plastics from Coventry. The Birmingham firm admitted certain of its staff were influenced to transfer by the attractions of the town and country but chose Brecon since it had industrial land for development, the council would assist with housing, and able to cover S. Wales – while the clothing firm did because "then the nearest place with a population large enough to supply a reasonable number of female employees, that lay within a development area, and the Welsh Board for Industry would build a government factory for us". The clothing firm could still run things from Worcester, an easy day trip 65 miles away – and the engineers from Birmingham, where any "specials" were made. The asset of Brecon was being able to expand, but the engineers had "to take people from agriculture and train them" and found it "difficult and quite often impossible to attract technical staff".

The four historic towns in the Home Counties also had a number of industries moved out for more space, but from London and often even from the suburbs and commuter towns in their direction: to Faverham from Bermondsey and Woolwich; to East Grinstead from Greenwich, Rotherhithe, Crawley, Croydon and Oxted; to Chichester from Hendon; and to Winchester from Kingston, Bromley, Woking, and Camberley. In almost every case the site was described as "the only one available", though several firms tried to keep as close as possible to the old works to keep the same personnel. Some however did investigate other towns – one firm having considered Birmingham, Swindon, Portsmouth chose Winchester because "little industry and MD liked area himself", and an insurance consultant who wanted "nice place, near main line station for London, good schools" moved out from Central London to Chichester, rather than Bognor, Lewes or Worthing.

As a contrast to previous towns, probably because these towns were in desirable commuting areas, the firms all transferred their management out when they moved; and in addition many bright new industries, were started up in these towns, often by entrepreneurs who preferred not to commute into London. As one put it, "the firm could have been established anywhere in England, but Mr. — already knew and liked East Grinstead and as land was available here at that time, he settled here. Anyone choosing a large town to establish their business must have forsaken the art of living! Life in a small country town is every respect much easier . . . we are near London and yet away from the turmoil. Definitely we have a lower staff turnover, although the rates of pay are not lower than in London. Our staff have all been recruited locally . . . and our customers are all over the country." New firms in EG include three with HQ in Switzerland who find it useful to be near Gatwick and Heathrow, and, two firms making control equipment for lathes, originating from one inventor who claims he set up in EG because his foreman became crippled and lived there. In Faversham a brush company was started by a man retiring there after the war; in Winchester, Conder, the second largest steel construction group in U.K., was started by a local man, the present chairman, in a village forge N. of Winchester in 1947; and in Chichester there were two firms started by people coming there for the sailing!

These four towns do also have "historic industries" and ones based on geographical factors. Faversham has East Kent Packers and Smedleys, drawing on its surrounding fruit farms, two working breweries and a gunpowder factory on the marshes. East Grinstead, between London and the coast, is regarded as a good centre and has a wholesale chemists and the C.E.G.B. Winchester has broiler chicken equipment, a pie factory and a famous nurseryman not as rooted in the soil as might be thought: "the only reason that our business is established in Winchester is that in 1864 my grandfather and his wife spun a trencher to select between two small floristry businesses which were then on the market, one in Winchester and the other outside Bradford in Yorkshire. If I were choosing a site for the type of business we now operate I would not choose Winchester because of the nature of its poor chalky soil."

And Chichester, besides various agricultural and milk distribution industries, has as its largest employer a meat and fish paste firm founded in 1750 and long associated with the city. When asked about the advantages of operating in Chichester, the Managing Director said this association "is in itself of enormous value which one cannot measure. If we were to move, we would have to take with us our key personnel. . . . What would this do to people? In business one's chief and most value asset are people. The fact we are in a famous Cathedral City has no bearing whatsoever on our being in Chichester, despite the fact we endeavour to run this business in a way we believe that God would have us run it and we try to buy and sell and treat people in a way we believe that Jesus Christ would have us do it if He were alive and with us. The fact we are near the sea and a holiday centre can possibly be of help, because our factory is the only one of its kind open to visitors whenever they like, and we get people from all over England who are on holiday in the Bognor area and I believe they take away quite a good picture with them."

An extension of setting up in a new factory on the edge of an attractive country town is to buy up a large country house and operate from there; the atmosphere impresses clients, it is an attractive working environment – particularly for research staff, and there is plenty of room to expand. Large houses used in this way are common in the South-East and Midlands. Outside Winchester are the I.B.M. U.K. Labs in Hursley Park, previously occupied by Vickers in the war; I.B.M. chose to be near Southampton University and moved to Hursley temporarily, but staff found they liked the panelled rooms and park, there was plenty of room and as the cost of conversion was less than a new building, they stayed there.

East Grinstead has in its surrounding big houses besides a number of schools, the Scientologists, the C.E.G.B. and a specialist property maintenance firm whose MD in 1950 apparently "wanted to get out of London because of the threat of nuclear war"!

The industries in the West Country towns showed all the types already encountered, though with a marked difference the further one got from the centre of the country.

Tewkesbury, near the Midlands and the aircraft industries of the Vale of Gloucester, was as full of engineering as East Grinstead and a number of the firms were founded there by people who liked the area. At nearby Ashchurch were Dowty Seals and Mining, part of a hydraulics group employing 14,500 based at Cheltenham; several firms moved from Birmingham, several founded by "Brummies", and several started up by locals. There was the familiar small clothing firm (based in Birmingham), and milk distribution, a Cold Store, crates for the Vale of Evesham, a flour mill and farm buildings (moved from Evesham). An electronics research group, based at Bracknell, had set up in Tewkesbury in 1965 and expanded considerably, and outside at Stoke Orchard, the Coal Research Establishment was founded in 1948 because "fairly central to coalfields, better *not* to be in a divisional colliery, and research flourishes best in the country."

In the famous cathedral city of Wells geographical factors predominate, for there are two paper mills using the unusually pure Mendip water (and an engineering firm which started to service them), a Cheddar cheese store, a creamery, an engineering group that makes dairy handling equipment, and a sheepskin firm (with 30 women outworkers) set up by two directors who had worked in Glastonbury and Street ("local labour used to doing this kind of work, but women are a funny lot; a group comes, then they go."). But the biggest employer is the electronics research division of a large electrical group, which bought up a firm directed to Wells during the war by the Board of Trade; since they do defence contracts, they found it useful to be near the Admiralty at Bath and the Army at Warminster, but they were short of skilled engineering labour, which had to come from Weston and Bristol. However the staff and graduates value being at Wells and most live there, and one person came back from the U.S. specifically to work in Wells, rather than Middlesex. And a small firm making special insulation for a national market is in Wells because the MD's parents spent their honeymoon there, and came from London in the war; he thought it "worth £1,000 a year to live in Wells."

Sherborne and Wilton both have complex "historic" industries that have adapted to stay in business. Marglass employs over 600 at Sherborne and makes glass-fibre in a former silk mill and, though it is a business that can only go up to an optimum size, its expansion is limited by shortage of labour and is only possible at all because of the labour pool of Yeovil 6 miles away. The Wilton Royal Carpet Factory, employing 350, with similar problems, has factories at Romsey and Southampton ("easier to keep unions away in the country, but better to have larger labour pool"). Also in Wilton were the Southern Command of the Army, a felt manufacturer founded in 1800, and agricultural engineering and a wholesale grocer – both finding Wilton, with its position near but not in Salisbury, an excellent centre for the South and S.W. Sherborne had engineers specializing in stainless steel originally associated with a large dairy, a local printer (as found also at Chichester and Wells), a glove manufacturer with 100 outworkers, a soft drink firm distributing from Exeter to Bournemouth, a firm making photographic equipment ("Sherborne is near the centre of the market which is the Midlands and South; Northerners don't spend money on cameras and cars and aren't conscious of their environment"), a firm making fibreglass mouldings ("if we can't make what we do, we'll stay in Sherborne and make something else"), a nutrition consultant, and the Country Landowners Association's Game Fair.

The S. Devon borough of Totnes has by contrast no engineering industries at all, though it is a considerable agricultural and distribution centre – with a large creamery, a bacon products factory, a large timber yard (with a boat every week or so up the Dart from Archangel), "Tuckers of Totnes" clotted cream toffees, and the Dartington Hall rural industries just outside. There was one unexpected "find", a local farmer who had set up as a management consultant in a historic house in the town centre; but, despite being on the main London–Plymouth railway, even he was finding Totnes too remote (too far to go up to London and back in a day), and was moving to a Georgian house in Bath.

The fact there seems a geographical limit beyond which "footloose" industries will not go, whatever the attractions of the countryside or its female labour, is emphasized by the contrast between the last two towns visited, the two Suffolk towns of Sudbury and Southwold.

Sudbury, historically a "silk" town like Sherborne, is now becoming, with Great Cornard, an overspill town for London; two firms made silk ties, one silk fabrics, there was plastic matting and a branch of Viyella (though *knitting* rather than weaving), while in flatted factories were small engineering firms moved out from Romford, Hainault, Tottenham. However, the biggest firm, employing 1,400, making diesel injectors, was dispersed from Acton by the government during the war; they needed the overspill labour to expand, and Sudbury was not badly situated for supplying their main customers, at Peterborough, Coventry and Dagenham. A local garage has set up Gainsborough Petrol (importing via Felixstowe), the nearness of the East Anglian estuaries was considered an asset by a local boat builder; and a firm making excavating equipment thought "Sudbury not remote; plenty of engineering in the area, anywhere between London and Ipswich O.K.".

Southwold however is 35 miles beyond Ipswich. It has a private girls' school (outside the borough), an upholstery firm in an old warehouse (who surprisingly said "transport costs compared favourably with our other factories in other parts of the country"), a small electrical firm, some extremely sophisticated shops, a local brewery and a few fishing boats. The electrical firm had been encouraged to move from Romford by the B.O.T. and unlike the industries encountered elsewhere was making a mass-production rather than a specialist high-value article; it did in fact prove to be no model for rural industry, for the firm lost an estimated £30,000 by the move, and when interviewed the Official Receiver was in. As the table shows, Southwold is a favourite high-class seaside retirement town (apparently many are bank-managers who retire at 60 and apply for work, thereby boosting the local exchange unemployment figures to the highest in the county!), and this is where its economic future of the town lies. It needs no industry, unless it is related to this function – like the local brewery whose success springs from its popularity with discriminating people visiting Suffolk for their holidays or retiring there. Here is an extract from its literature which combines a "historic" industry with the "image" of a historic town: "This is about beer – some of the best in all England – about its brewing in a fine old seaside town and the places where it can be found, whether comfortable hotels or attractive inns on Suffolk's quiet coast or traditional village pubs deep in the surrounding countryside. The beer is Adnams, whose brewery at Southwold stands little more than a stone's throw from the sea, close to a beautiful 15th century church in a town unmolested by the strident hand of the mid-20th century."

CONCLUSIONS

What conclusions can be drawn? If nothing else, that the reasons for the location of an industry in a town and its successful operation there are varied and complex, but there still seem to be two types of industry not found in these small towns – the large production industries that need a large workforce and the specialist government and information industries, such as the news media, that are concentrated in London. But excluding these, a number of specialist science-based industries, like those in the U.S., were found that liked operating in these small country towns for a variety of reasons: space to expand, lower rents, less traffic congestion, available labour (particularly married women), and because of the more attractive working environment for its skilled workforce and its professional and managerial staff. The question of personnel is very important, because the more sophisticated the product, the less important the transport costs and the more important it is to attract and keep key personnel; some firms admittedly had difficulty in recruiting skilled working men, but quite a few towns seemed to have the best of both worlds, by being, like Warwick, a small town near a large conurbation.

There did seem to be important differences between the regions, with the North not sharing the same managerial attitudes as the Midlands and the South, and locations beyond say Taunton to the S.W. and Ipswich in East Anglia did seem too remote. Still, as these industries all seemed very much the sort of bright new industry on which the economic future of the whole country depends and, as this seems increasingly to be found in these small towns, one is optimistic about their economic base, all the more so as people become more and more conscious of their environment and are moving out from the large cities and conurbations.

As far as policies on conservation were concerned, two facts emerged. Somewhat to my disappointment none of the manufacturing industries encountered wanted to operate in the central area, except a couple of the clothing firms who found it easier to recruit their female work-force if they were near public transport and the shops. And only the larger firms interviewed were interested in whether the towns were growing or not; the smaller firms were all much more concerned with the *quality* of their labour than its *quantity*.

The planning implications seem to me therefore that, instead of being obsessed with the Great God Growth, which seems inevitably to ruin the character of a historic town and whose disbenefits have been graphically described by Mr. Mishan,[5] the planning authorities should limit the growth of historic towns (or else adopt tough policies on limiting the shopping and office uses of the historic core (which continental authorities seem capable of doing), and channel growth elsewhere; and on the outskirts an industrial estate should be provided for light industry, with plenty of room to expand, while the somewhat untidy clothing firms should be allowed to stay in the centre if they want to. Not only should historic towns be protected from the local shopkeepers, and often council officials, who want to ape the big towns and destroy everything of any quality their town possesses, but the environmental qualities of the small historic towns should be studied and applied to the *larger* towns, before they become like many American cities, deserted except for drunks and the very poor. Our historic towns are fast becoming the only pleasant urban environment left in this country; instead of "zoning" out all their diversity and activities according to dogmas which are generally agreed to have failed, we should question our procedures in the big towns and the New Towns as well; after all, if the authorities had fulfilled their 1947 obligations for "the proper planning" of our towns, instead of becoming obsessed by the financial advantages of central area redevelopment, the conservation movement need never have arisen.

[5] E. J. Mishan: *The Costs of Economic Growth*. Pelican, 1967, 30p.

"There's Another Country . . ."

John Blackie

1

It would be easy, now that the reef booms,
To gather in groups singing, fancying
Stray lights in the clouds gleams from afar,
Hearing in the crash the word of the eternal,
Catching in the lulls the whisper of God;
Symbols invoked too often, symbols only,
Not illuminating the darkness gathering round,
False signals from a coast that has not shifted
Mistrusted, misunderstood and disregarded,
Their too familiar flash ignored and the coast
Hardly believed in least of all as a danger.

The furrow behind is white in the murk
Leading back to seas no more familiar
Than that in which we sail,
But an easy track for memory to pick up,
Sailing back to the calm bay and the quay,
To the fisherman's fire and the stories on the beach.

2

At the house above the bay the old retainers
Gathered to see us leave, waved and turned back
To the long rooms, mirrored, smelling of woodsmoke,
And the portraits staring from a still older day,
And set about their tasks in the master's absence.
When winter came to those islands the door stood open
And from the hills behind the harbour shepherds
Trudged down bringing their flocks to richer pastures
And glanced through the door in the master's absence.
No long voyage had we intended in time.
For the winter feasts we would come back,
The master re-installed, benign, magnanimous,
The retainers kneeling, at once respectful and friendly
And fat beasts in the stable. But contrary winds
Carried us to another country.

Here steel masts

Held huge forces in suspense. Wonder
Was of steel pistons and gearing, marvels of power
Harnessed but menacing, visions of lines
Converging and systems of wheels, dreams
Of space and the measureless measured.
Here a proud people dwelt needing no clocks
Who had reared this forest of forces, before whose
touch
Space receded and the dimension of time
Became fluid. The shadow of the scaffold
Fell upon the carpenter, the odour of oil
Was in the king's nostrils and the lover's hands
Were bruised with iron.

3

It was possible to leave the ship, seeking
Quiet courts and company and leisure
In which to pursue the truth, finding pursuit
It self a balm and the lack of an answer
Almost a re-assurance of the answer's importance.
And there would spring up a tune from the void,
Argument suddenly yawning to reveal the chasms,
Argument suddenly clearing to reveal the heavens,
Argument leading to the mountain with no door
Opening in the rock nor steps for scaling,
Only the turning back by the way by which we came
To wait once more for the music that would guide us
For the re-embarkation on the voyage we could not
escape
To another country where we should still find
ourselves.

4

Below decks out of the sunshine men kept
Hidden, ready when the hour came to rise,
Seizing freedom, claiming justice, destroying
The oppressors and the sons of the oppressors.
All men of true heart joined them
Turning, some against their kind, answering
The clear unequivocal trumpet, rallying
To the bright undecorated flag, dying
For the warm-hearted, the generous cause.

This love, this ardour bred strangers, victims
Hanging on the cross-trees, reviled and remembered,
Martyrs or malefactors stoned or cheered.

We did not know what it was we remembered
Which drove us, tortured us, turned love to hate;
We did not understand why the shadow of nightmare
Fell on our dream of love and we were torn
Between opposites that resembled identities,
United by what horribly cast us asunder,
Hearing still the trumpet but forwandered,
Heart broken by friend and enemy, loving both,
Hating both and then, indifferent to either,
Crying for the mediators and the healers.

5

We turned our faces from the sad company,
Who finding sin in delight discovered delight
In sin hidden, indulging a loud indignation
Expressed in well-worn phrases about others,
Themselves secretly deciphering the codes on privy
  walls.
We turned our faces from them and glorified the flesh.
Our bodies in the sun and in the blue water
Among the pine trees at the edge of the water
Blossomed and ripened as shame dropped from them.

This letting in of light was a sanctification
Redeeming those who had mated among the wheat
Who had poured their seed upon the corn,
Those who had hidden the young maidens,
Who had practised enchantments upon the teeming
  mother,
Those who in the locked bedroom had shuddered
At their own guilt powerless to shift its weight.
All these awoke from the ancient nightmare
Finding redemption in the sun and spring of the day.

It was this life, love and creating
Leading to purer sources
Which brought us to reconsider death and birth,
Consequences of the casual and mechanical,

Of passion, of water and sunlight
Of the fearful, ignorant and guilty,
Of high communing and cerebral determination,
All of them giving and taking away life
Making and slaying poets and tyrants.

6

Those who came with us and whom night and ocean
  took
Whom we could not find among the seas or the stars,
To whose bright day there was no going back –
Was that echo of their voices caught on certain nights
Delusion, or could we begin to guess
What they were getting at?
Was it a general feeling of sad mortality
Or a fleeting insight which so moved our hearts?
It seemed certainly that, as the voyage lengthened,
These lost, unmarked in the unattainable seas,
Spoke from some harbour that we had not reached,
But hardly as yet in terms
Understandable without an interpreter.

7

Peering into the darkness ahead,
Listening to the boom of the reef,
Watching for lights on the rocks,
We looked for the vision upon the waters.
It had escaped as the waters behind had escaped,
We had missed it as we had missed the coast
The ship was passing as we slept;
Or some other ship saw it and the message failed,
Yet we saw the lights as she sank,
Heard voices but arrived too late,
Foiled by the slow duration of a minute,
Dull-witted when extra perception was needed,
Slow-gaited when a quick grasp was essential,
Heavy-hearted when we should have stirred at a touch.
Now in this wind, darkness and rain
What can we find before the hour strikes
What is left of the vision that we missed?

8

Then we were visited by old men's thoughts.
The promise of the voyage had been broken,
The dedication was untranslatable.
Too easily they come, such thoughts,
As, earlier, came too easy melancholy,
Attitude struck with automatic grace
Or fallen back on as the best way out.
We must return always to the moment of life,
The tide and wind felt in the hair,
The leaf opening as we watch
The iron glowing beneath the hammer,
The transubstantiation;
Neither such things recollected in tranquillity
Nor foreseen as possible experience.
But at the moment of life
When experience can make them timeless.

9

The road longer than we had remembered,
Harder to find and night falling quickly
On murky fields and looming distant woods;
No sign-post but the half forgotten star,
No light left save through the half-door
Shining on some unexpected faces
Not seen for long, who might not have made the journey
Or arrived in time but there, yet hardly greeting us
Or with a nod only, neither they nor we
Needing words, understanding the birth but not the words,
Hearing the word, knowing it, seeing it
In the child and the peace of the child in the stable.

What are we doing on this dark voyage,
The reef booming ahead, the wake lost astern,
Starless, the watch wearied and half blind?
Was that tender vision no more than a gesture,
Nostalgic evocation of the island winters
With the shepherds trudging from the hills?
We cannot follow that furrow. In the gloom
Through which we drive the way must be found
And in the vision moving on the waters.

10

And so we came once more to scan the wide waste
Looking for the vision that would tell us the way,
For the figure treading the waves and calming them
For that familiar figure whom we had not recognized,
The fisherman casting his net in the distant island,
The shepherd who brought his sheep down from the crags,
The master long absent from the unconsecrated house,
The carpenter, the lover and the king
Bruised and exiled from the confident city,
The martyred liberator, the sanctifier of the flesh,
The interpreter and healer of the dead.
We had met him at every veering of the wind
Unrecognized until he now took form
From all those others and was revealed as one,
The light that illuminated the ancient dark,
The life animating the dead waste,
The one way to another country.

11

The way may be found secretly
Must be followed openly.
The traveller cannot take cover in darkness
Slipping unnoticed from wood to wood,
Lying up in the daylight.
The secret communing of the heart
By which the way is at last discovered
Must be succeeded by an open journey,
Travelling to meet the vision of great evil
Rising in the east in the course of the star.

The vision in the east is beautiful.
It has the beauty of submission
The submission of the heart,
It has the beauty of certainty
The certainty of death,
It has the beauty of unity
The unity of generation.

The vision in the east is beguiling.
It demands as a woman demands

But has no breasts of mercy.
Its eyes shine but reflect nothing,
Sparing you the sight of yourself;

Its hands grasp with the firm grasp of a lover
But do not release you.
The vision on the waters is beautiful.
It has the beauty of submission
The submission of the will;
It has the beauty of certainty
The certainty of life;
It has the beauty of unity
The unity of young children.

12

The men coming from the east
Whom we shall certainly meet
If we do not depart from the way –
It will not be easy to remember
That they are our brothers;
It will not be easy to recognize them.

These men have made their submission,
They have declared their faith.
We shall not recognize them
When one day or another we meet them
Coming from the east,
If our faith is not decided,
If we do not know to whom we have submitted
If we are in doubt about the way.

Though they should slay us
Yet they are our brothers in Christ,
Though we should destroy them
The cross does not destroy them,
Though there is division
Yet we meet them upon the way,
Though our quarrel is here
Yet we shall come with them
To the other country which they seek.

These men too are unjust and blind
Harsh and unfeeling,

They will not recognize us
And we shall only meet them
If we do not depart from the way.

13

Not much will survive,
Not much of the house above the bay,
The insulation of property,
The escape to Loch Linnhe
And to the shade of the arbutus.

The proud city has no continuance
Nor the cushions of wealth
Nor the resorts of gentility.

The cloister will not exclude
The learning of the east,
Nor the philosophers find
Answers to the question
That the east fires.

The flag of tolerance will not rally,
Nor the flag of liberty unite,
Nor the flag of equality
Raise a cheer.

The agonising face of truth
Can hardly be borne,
Lifted up, it draws
Only those who dare to look,
That face only can illuminate,
That tree only give shelter,
That city only continue,
That word only whisper the answer,
That light alone outshine
The fire in the east.

14

The naked men are clothed only
With the divided raiment of the naked;
The hungry and thirsty fast
Only until the coming of the slain;

The slave's freedom is not assured
Save by the intercession of the bound.
We attain to a kingdom
Only by the path of rejection,
Only upon the lips of death
Tasting the fullness of life.

15

The darkness of midwinter morning
Turns grey and hollow the bell rings,
There is no babe in the falling stable,
Out in the fold no angel sings.

No starled wizards westward hurry
With myrrh and frankincense and gold;
The congregation stir and mutter,
The very young, the maimed, the old.
Yet in this season we discern Him,
Not in the fulness of the spring,
In these unlikely ones adoring,
The child, the shepherd, and the King.

Till the warm love ourselves have banished
Rises on us this Christmas Day
And on another country shining
Reveals the purpose and the way.

Review Articles: *"Quantum Theory and Beyond", ed Ted Bastin (C.U.P.)*

Cambridge University Press, 1971; 345 pp., £5

I

Everyone is intrigued by quantum theory because it is strikingly different from its predecessors as a description of the observed world. The purpose of the colloquium which gave rise to the present volume "Quantum Theory and Beyond" was to air this difference and the variety of attitudes which have been adopted towards it. One should really say *dissatisfied* attitudes since it is the belief of the organizers of the colloquium that quantum theory is shot through with inconsistency and is ripe for restatement.

While everyone would agree that there is yet much to be learned of the foundations of quantum theory I think the editorial view is too sweeping. In particular it seems unfortunate that they were not led to include in the list of contributors an unrepentant champion of what the editor in his introduction calls the mainstream point of view. The reason for the omission is made clear.

"You might say that it (mainstream point of view) is what the average physicist who never actually asks himself what he believes on foundational questions, is able to work with in solving his detailed problems." Obviously no such contributor would have anything to say.

This is too dismissive of what practising physicists do and of the power and subtlety of thought involved in solving detailed problems. The above remark appearing as it does in the second paragraph of the introduction leaves one feeling rather dissatisfied. This feeling is not dispelled by the rest of the introduction which contains a baffling assessment of Dirac's admittedly rather terse account of the foundations of quantum theory, more sweeping remarks about the evolution of attitudes in the scientific community and towards the end arrives at the unjustified conclusion that there exists ". . . a general agreement that there is something seriously wrong with the combination of quantum theory and continuity". Of course not all conclusions reached in an introduction need be defended there. However, as an assessment of the subsequent contributions the editor's comments are wide of the mark. Much the same could be said of his prefatory notes placed at the beginning of each section into which the book is divided.

After this uncertain beginning it is a pleasure to read Frisch's skilful essay in which he lucidly explains what is involved in making a measurement in situations controlled by quantum mechanics. His main point is that measurement is only completed when an irreversible record of the state of the system has been made. The convincing nature of his analysis is due to the fact that he bases it on a specific example carefully discussed in detail. If one wished to take issue with him at least there is a basis for discussion. This essential virtue is not exhibited to the same degree if at all by subsequent speakers.

He mentions the bizarre case of Schrödinger's cat done to death in a closed box as the result of an explosion triggered by the decay of a radioactive nucleus. The nuclear decay is governed by quantum mechanics. Does a thorough going treatment require us to say that the cat is at least partially alive until the box is opened? Perhaps the debate on this point could be sharpened by imagining the same fate arranged for a fellow citizen. The case for the defence could be based on the plea that the policeman who opened the box and discovered the body was the real murderer!

The next two papers by von Weizsäcker and Bohm discuss briefly Niels Bohr's views. In particular they are concerned with Bohr's insistence on the role of classical concepts. One can imagine two ways in which they could play a role. First, the apparatus of the experiment comprises identifiable objects which in certain respects at least are classical objects. Second the non-classical objects being observed can have attributes that one would wish to associate with classical concepts like momentum and position. Neither paper discusses these points in a particularly clear fashion. Professor von Weizsäcker missed a good opportunity for clarification when he referred to a conversation between Bohr and Teller on this topic. He reports only Bohr's final remark. It would have been interesting to have heard Teller's side of the argument.

Before going on to discuss the next group of contributions on the measurement problem it will be useful to establish an illustrative example. We will discuss Dirac's example of the polarization states of the photon.

The photons we will suppose are emitted from excited sodium atoms. Each emission is recorded by the recoil of the atom. The photons then approach a Nicol prism N_1. If they pass through, this is recorded by a photo-multiplier on the other side of the prism. By recording a sufficient number of events the probability P for passage through the prism can be established.

Now a second prism is inserted into the photon beam after the first and a new probability P' for passage through both N_1 and N_2 established. By performing suitable combinations of experiments we can verify that

$$P' = P \times P(N_1, N_2)$$

where $P(N_1, N_2)$ is the probability of going through N_2 having passed through N_1. Furthermore

$$P(N_1, N_2) = |\, \varepsilon_2{}^* \,.\, \varepsilon_1 \,|^2$$

where ε_1 and ε_2 are the two-dimensional polarization vectors associated with the prisms. Given this law we can reinterpret it to mean that the photon which passes through N_1 is in a state ε_1 and the probability for it to be in state ε_2 (i.e. to pass through N_2) is just given by the usual quantum mechanical rule for calculating probabilities from the state vectors of the system.

There are many lessons one could draw from this mini-version of quantum theory. Two important points are

(i) The probability interpretation is essential.

(ii) Macroscopic objects are essential since they are the means of creating the filters (the Nicol prisms in the above example) whose mutual probability functions ($P(N_1, N_2)$) are the observable quantities which are to be predicted by the theory.

Completing quantum theory involves using it to explain why filters behave as such. That is, why quartz crystals exist and why they have different refractive indices for the two polarizations which they can be used to separate. I don't think anyone supposes that this programme will really fail. Furthermore there is no sign here of the infinite regress associated with von Neumann's analysis of measurements nor does the above programme involve a logical circle as Bastin suggests in his introduction.

The first paper on measurement is by Groenewold who emphasizes the necessity of the statistical interpretation. He seems to favour von Neumann's analysis of measurement only he believes the chain can be broken in some way. His comments are couched in rather general language and are rather difficult to assess. Prosperi's paper which follows deals with the problem of how large scale bodies obeying classical mechanics to a good approximation, can emerge from quantum mechanics. Unfortunately his contribution is a rather abstract account of a much longer piece of work and his lack of specific examples rather detracts from the value of his paper. Bub in his paper identifies another problem (though not very clearly) which is also associated with that of Schrodinger's cat. Briefly stated we can put it like this. A cup of tea (macroscopic system) can be at either end of a table. Both these states are allowed and observed. In principle quantum mechanics also permits a state which is a superposition of these two. No cup of tea has yet been induced to enter such a state. To use the jargon of the trade we say that effectively, a super-selection rule is operating which prevents us superimposing the two states. This situation occurs already in quantum theory in connection with charge and baryon number. However, the problem here is to show why it operates for large scale objects.

Of the remaining two papers Whiteman's seems to me semantic quibbling while Garsten's is I am sure, wrong, in particular his opening remark:

> "The problem of measurement in atomic physics belongs to the discipline of statistical mechanics."

The papers discussed so far represent the heart of the book. While they do raise the basic problems of quantum theory they don't explain them very clearly nor, of course, do they overcome them.

The rest of the book is of very variable quality. Most of it is without sense or interest. One could except perhaps Bohm's account of hidden variables – though this remains as unpersuasive as ever – Chew's paper on S-matrix theory – though this has to do with relativistic quantum theory and is really quite mainstream in the sense of the editor.

Perhaps one should also mention Pattee's eccentric but intriguing article "Can Life Explain Quantum Mechanics" and finally the two discussions (p. 129 and p. 321) which can be read for the amusement of their self-parody.

All in all I think this book does not represent an advance in the problem of understanding the foundations of quantum theory. It could have been a useful forum for discussion but has failed because the organizers' wrong assessment of the urgency of the problem has led them to try to cover too wide a field. Furthermore the general level of exposition is poor.

Ian T. Drummond.

II

This is a very interesting collection of papers on the foundations of quantum mechanics. While some of the papers include novel uncontroversially scientific results, much of the book consists of matter where the various participants are in fundamental disagreement with each other. Since I myself regularly teach a course on the philosophical foundations of quantum mechanics, perhaps the best service

I can do the potential reader is to state what I see as the crucial foundational problem and to discuss how the contributions to this volume which most interested me attempt to cope with it.

The fundamental problem of present quantum mechanics, as I see it, is not that of its indeterministic character but rather that of reconciling the *deterministic* character of the basic equations of quantum mechanics with the indeterministic character of the postulates which tell us how to calculate the results of a measurement. The difficulty is that if we start with a micro-system in a definite quantum mechanical state and let it interact with a measuring apparatus, also supposed initially in a definite quantum mechanical state, then the Schrödinger equation is applicable to such an interaction and tells us that after the interaction the pair of systems will be left in a state wholly determined by the initial states. This state is formally a *superposition* of the various states each of which *would* correspond to a definite result of the measurement. Now all would be well if we were entitled to treat such a superposition as merely an expression of our ignorance of the exact state, for the result would then agree with what the quantum mechanical postulates governing the results of measurements tell us. But in fact it is a fundamental theorem of orthodox quantum mechanics that such a superposition cannot be interpreted simply as an expression of our ignorance. (The existence of such a theorem was already recognized intuitively by Bohr and Heisenberg in their early discussions of measurement in quantum mechanics. The first formal proof was due to von Neumann. The result has since been considerably sharpened as a result of subsequent studies by, among others, E. P. Wigner, H. J. Groenewold, A. M. Gleason, J. M. Jauch and C. Piron, L. Cohen, J. S. Bell, S. Kochen and E. Specker, and A. I. Fine. These results rule out indeterministic hidden variables just as much as they rule out deterministic ones.) The sort of straight-forward probabilistic interpretation of quantum mechanics which was originally proposed by Born and which is still a favourite of philosophers is thus irreconcilable with the formalism of quantum mechanics. But we are left with the central paradox that the Schrödinger equation and the interpretative postulates seem then to be formally inconsistent with one another.

The first paper in the collection, "The Conceptual Problem of Quantum Theory from the Experimentalist's Point of View", by O. R. Frisch, discusses this fundamental issue in a clear and illuminating way without however pretending to offer a solution.

The volume's first proffered solution to the problem occurs in

C. F. von Weizsäcker's paper on the Copenhagen interpretation. The Copenhagen interpretation of Bohr had attempted to avoid the paradox by refusing to apply quantum mechanics to any macroscopic measuring apparatus. To the objection that such a proposal would completely destroy the unity of physics, Bohr's reply would have been that it is not the nature of reality which prevents us applying quantum mechanics to large collections of interacting atoms, it is rather that it is psychologically and epistemologically impossible for us to construct any picture of an objective world of macroscopic objects in terms other than (essentially) those of classical physics. Therefore, according to Bohr, the very way in which we conceive of the properties and behaviour of a macroscopic measuring apparatus prevents us from applying the quantum mechanical formalism to it. To this view there are two serious objections: first it cannot resolve the paradox unless it can be supplemented by a demonstrably consistent rule for deciding to which systems the quantum mechanical formalism is fully applicable and which must be treated classically; second we need to be offered some convincing reason why reality cannot be conceived directly in quantum mechanical terms in spite of the fact many of us have no difficulty in conceiving it directly in other non-classical terms (for example in special relativistic terms). Von Weizsäcker proposes that it is the fundamental connection between measurement and irreversibility that provides the essential answer to both these objections.

Von Weizsäcker believes that the consistency of this proposal is ensured by the fact that it dissolves the paradox by allowing us to regard the end result of the measuring process not as a "pure state" but as a "mixture". He attempts to dispose, in a footnote, of a well-known objection to this proposal which has been emphasized, many times, by Wigner. The objection is that however much information about the precise quantum mechanical state of the measuring apparatus we may lack initially or lose as a result of the irreversible features of the measuring process, the laws of quantum mechanics take us inexorably from an initial superposition of states of the microsystem (corresponding to different possible values of the parameter to be measured) to a resultant superposition of states of the total system including the measuring apparatus. Von Weizsäcker purports to answer Wigner's objection by taking the phrase "hence cannot describe the irreversible traits of the measuring process" to refer to those irreversible features which would also arise in the classical case and claims that a standard classical solution to this difficulty is equally applicable in the quantum mechanical case. This seems to me a mere equivocation. Wigner clearly intends to refer to the peculiarly quantum mechanical irreversible feature associated with the "collapse of the wave-packet". Von Weizsäcker's proposed treatment indeed leads to the representation of the final state by a "mixture", but the pure states making up this mixture will not be pure states of the desired kind, but will be precisely the undesired superpositions of such pure states. I would not labour this point were it not that similar suggestions for a ready "dissolution" of the basic paradox have issued from so many eminent authorities as to have almost become an integral part of the orthodox theory.

The most serious attempt to show that quantum mechanical statistical mechanics can indeed dissolve the paradox was made some years ago in a paper by A. Daneri, A. Loinger, and G. M. Prosperi. In this volume Prosperi outlines their approach and Jeffrey Bub attempts to show where it begs the question. Bub's statement of the basic problems is sufficiently clear to be worth quoting. At the very beginning of his paper he tells us:

"The measurement problem of quantum theory is the problem of providing an explanation for the projection or 'collapse' of the Hilbert space vector – the so-called 'quantum state' – onto a particular member of a certain relevant set of eigenvectors during a measurement process – representing a stochastic change, which *prima facie* is inconsistent with the unitary time transformations of the theory."

Now the essential feature of this "collapse" is that it is necessary in order that the measuring apparatus be left in a definite macroscopic state after the measurement. Daneri *et al*. claimed to be able to show that such a result follows anyway from a correct application of quantum mechanical statistical operator embodying our information process without our needing to import any special "projection postulate" as a supplement to the basic dynamical equations of quantum mechanics. It is a pity that Prosperi's article concentrates on technical details rather than on explaining at a general level what special feature of the approach of himself and his colleagues, in his opinion, "does the trick" in resolving the paradox. Bub's view is that Daneri *et al*. fail in fact to introduce fully observer-independent macrostates of the measuring apparatus and thereby simply side-step the issue. Prosperi's reply is unfortunately not printed.

I am myself tempted to locate an essential sleight of hand at another point in Prosperi's analysis. This analysis depends on demonstrating the effective equivalence of the exact dynamical equations and certain approximate equations. In demonstrating this equivalence Prosperi concentrates attention exclusively on the quantum mechanical statistical operator embodying our information about the quantum mechanical state. Unfortunately while such a statistical operator embodies all the information about the state which can affect subsequent predictions it does not embody all that quantum mechanics purports to tell us about the objective situation. In particular we can have the same statistical operator for a state which is a superposition of two states, where we are ignorant of the phase relation between the component states of the superposition, that we would have for the situation where the state is not a superposition of the two states but is known to be one of those two states but where we do not know which it is. Now, while a positivist might refuse to distinguish between these two situations, the presently accepted interpretative postulates of quantum mechanics in fact do formally distinguish between them. Indeed any attempt to revamp quantum mechanics so that the statistical operator rather than the quantum mechanical state were taken as the fundamental description of reality would seem to lead to a radical obliteration of the distinction between objective reality and our knowledge of it. But the prime motive of Daneri *et al.*, as I understood it, was to rescue the quantum mechanical theory of measurement from that particular undesirable consequence of von Neumann's earlier approach.

Von Neumann resolved the basic paradox ultimately only by relativizing objective reality (as reflected in the required definite result for any properly carried-out measurement) to the consciousness of some one particular observer. Of the contributors to this volume H. J. Groenewold seems to come closest to von Neumann in epistemological radicalism. Groenewold suggests that at the quantum level we must abandon "the hypothesis of an objective physical reality" and tells us that he does "not expect that a realistic picture which might adequately accompany the micro-quantum formalism will ever be found". On the other hand he assures us that "there is neither a logical contradiction, nor a vicious circle in the alternating use of the complementary classical and quantum descriptions". But abandoning the hypothesis of an objective physical reality is a high price to pay for restoring consistency here. Nevertheless I would not advise the reader to dismiss any opinion of Groenewold's lightly. On the logical and technical problems pertaining to the analysis of the interpretation of quantum mechanics Groenewold is one of the undisputed masters. However there is nonetheless one point on which he insists in the present paper which seems to me so radical that I doubt whether it can be right. As Groenewold observes, quantum theorists normally assume that if we are given a sufficiently complete description of the details of a single experiment – one involving, say, the passage of a single electron or photon from an emitter through a two-slit system to a photographic plate where it produces a single spot – then quantum mechanics essentially leaves us no choice as to the right kind of time-dependent wave-function with which to describe what has occurred. But Groenewold says that, on the contrary, we can only choose the appropriate wave function with which to describe the process after we have decided what is to count as an ensemble of repetitions of this experiment. And he tries to show by means of a detailed example that our freedom here can completely alter the quantum mechanical description of the process. He concludes that we ought, strictly, never to talk of the quantum mechanical state of an individual system. We ought only to associate a quantum mechanical state with a statistical ensemble of systems; the probability of any particular result of an experiment on an individual system is left undetermined by quantum machanics: Groenewold believes that only a hidden variable interpretation could determine it, but he is sceptical of the possibility of such an interpretation. I did not find Groenewold's detailed example entirely convincing. What is puzzling about his position is this: it is normally the determinist who refuses to associate probabilities with individual events; the indeterminist feels completely free to do so. Groenewold's suggestions would completely invert these relationships. The view that quantum mechanics is to be interpreted as a purely statistical theory is a characteristic thesis of philosophers sympathetic to hidden variable interpretations of quantum mechanics; but Groenewold, while defending the former, could hardly be less sympathetic to the latter.

That staunch defender of hidden variable theories, David Bohm, has contributed two articles to the volume. These make it abundantly clear, if it was not already so before, that far from hoping to escape from the epistemological obscurantism of Bohr, Bohm hopes to show that Bohr was not in that respect radical enough. What is called for in Bohm's view is "a movement in which physicists freely explore novel forms of language" and "new orders of necessity" in which, following Bohr, we reject any "kind of description which would make possible an analysis of the relationship between 'observer' and 'observed system', considered as separately existent" and accept that "it has no meaning to say, for example, that there is an 'observed object' that interacts with the 'observing instrument' ".

I fear that those physicists who are content to go this far along with Bohr will regard Bohm's latest hidden variable theories as pieces of gratuitous "philosophical" speculation, whereas those of us who think that there are genuine unresolved logical and epistemological deficiencies in the present orthodox version of quantum mechanics will not derive much excitement from the broader physical speculations of one who treats these deficiencies as if they were a virtue. We seem to have here a classic case of Kuhnian incommensurability: Bohm seems not only to differ from most of the rest of us as to the nature of the problems confronting us but seems even to see the world itself through completely different spectacles.

In contrast I found the style of J. H. M. Whiteman's careful analysis of "The Phenomenology of Observation and Explanation in Quantum Theory" surprisingly congenial, in spite of the fact that it too purportedly springs from the soil of Bohr's epistemology. In fact this paper presents the most sensitive appraisal of the relation between what the experimenter actually does and observes and the theoretical inferences suggested by quantum mechanical theory which I have yet come across. Whiteman rejects any prior commitment to a language of particles, of systems, or of states, for describing submicroscopic phenomena (believing that that is the route which leads inevitably to the measurement paradox) and, starting out from what seems to be simple common sense realism about the macroscopic domain, he attempts to set up for us a way of talking about the actual experimental phenomena which will enable us to give a consistent objective description of the statistical predictions of quantum mechanics. Of all the papers in the volume Whiteman's seems to me to contain the most promising approach to avoiding the central impasse of the orthodox quantum theory of measurement. Only when we have some way of giving a formally consistent objective account of what present-day quantum mechanics tells us about the results of experiments does it seem to me that we will be in a position to explore whether there is any possibility of alternative theories which would carry us essentially beyond the present theory in our understanding of the quantum mechanical aspects of nature. One hopes that Whiteman's interesting approach, which already leads him to make some illuminating comments about the directions in which one might and might not expect to be able to go "beyond" quantum mechanics, will not turn out to lead only to a language which raises again difficulties isomorphic to those of the orthodox quantum mechanical language.

Does the transition to relativistic quantum mechanics make any difference to the basic problems? Most recent discussion of measurement in quantum mechanics is predicated on the assumption that it does not. With this view I am inclined to agree but the present volume does include two contributions which remind us that we may be being overly naive here. Geoffrey Chew, "The Bootstrap Idea and the Foundations of Quantum Theory", emphasizes that the S-matrix approach to relativistic quantum mechanics which he favours involves no commitment to a space-time picture at the microscopic level, or to a wave-function (or state vector) that evolves in time, or even to operators associated with observables. Chew does not however discuss the measurement problem from the S-matrix point of view and I fear that, as concerns the measurement of, say, the momentum of a free particle in a superposition of two momentum states, the S-matrix approach has no more satisfactory an analysis to offer than the usual one with its attendant epistemological difficulties.

Y. Aharanov and A. Petersen's "Definability and Measurability in Quantum Theory" does not discuss the basic problem but does present interesting results on other aspects of measurement in non-relativistic and relativistic quantum mechanics. The authors point out that although the restrictions on forms of possible quantum mechanical interactions imposed by the various accepted conservation laws appear, from a formal analysis, to prevent us measuring certain observables (including, as it happens, position), this interpretation can be seen to be incorrect when we consider the conceptual origin of the invariance principles underlying these conservation laws and it is only in fact measurements of such chimerical observables as absolute positon (i.e. position relative to absolute space) which are formally ruled out by these restrictions. On the other hand they emphasize that in relativistic quantum mechanics, the condition that only local interactions should exist, which is imposed by the requirement of causality, does indeed place severe restrictions on which observables can in principle be measured and *inter alia* rules out the measurement of instantaneous momentum. It follows that relativistic quantum mechanics is open to an objection which is the exact opposite of the Einstein, Podolsky and Rosen objection to quantum mechanics: orthodox relativistic quantum mechanics allows one to predicate more aspects of reality than it itself allows one in principle to measure. This objection does not however apply to the S-matrix approach favoured by Chew.

Some of the other contributors to the volume propose more radical departures from the framework of current physics.

"The Unity of Physics", by C. F. von Weizsäcker, attempts to carry out a splendidly ambitious neo-Kantian reconstruction of the whole of current physics from the epistemological preconditions of experience. Entrusted to lesser hands such an enterprise would seem hopeless but von Weizsäcker tackles it with panache.

Atkin and Bastin also believe in starting from an epistemological analysis. They believe that a sufficiently judiciously chosen algebraic interpretation of their analysis may make it possible to build up space-time from scratch on a discrete basis. With other collaborators they succeeded in arriving by a surprisingly simple construction at the *terminating* mathematical sequence consisting of the integers 3, 10, 137, and (approximately) 10^{38}, which bears a certain resemblence to a sequence of reciprocals of possible physical coupling constants. In view of the crudeness of their model it is perhaps a little uncharitable to insist that, apart from 137 which is virtually chosen in advance, these numbers do not closely resemble the sequence of the reciprocals of the actual physical coupling constants: $1/15$, 137, 10^{10}, 10^{41}. But even allowing for "renormalization" it seems to me that such disparity is strong circumstantial evidence against the *present* approach of these authors providing the clue to the universe. (Even less auspicious is Atkin's tentative calculation of a lower limit of length of 0.814×10^{-13} cm. Dimensional numbers, unlike dimensionless ones, cannot be generated from nowhere, and, abstracting from Atkin's technical terminology, what he seems to have done here is to have set one gramme equal to one second and then taken the square root of Planck's constant in ergs per second.) I share the view of these authors that we can look forward to a future physical theory which will provide a much more fundamental explanation of some of the basic features of our universe than do the present theories and I also agree that when we have got this future theory we may well kick ourselves for not having anticipated many of its basic features more or less *a priori*. But I differ from them on the question of the best strategy to adopt in trying to advance towards such a theory. Human psychology being what it is, I think that there is a very real danger, if one adopts their strategy, of acquiring a self-reinforcing conviction that one's fundamental approach is essentially correct, that its initial apparent successes cannot have been a mere accident, and that the real breakthrough is just round the corner. Even Kepler's critical judgement was apparently blinded by what we now see as very superficial initial successes of his perfect solids theory of the ratios of the dimensions of the planetary orbits: he retained throughout his life the conviction that he had caught a glimpse of the mind of the deity and that the approximate success of so fundamental-seeming a theory could be no accident. Of course Kepler's attempt to arrive at a truly fundamental theory of the universe came centuries too soon and the "pure numbers" he regarded as basic are now regarded as having a complicated and rather uninteresting origin. I would be more convinced that we are now in a situation which is favourable to the adoption of a Keplerian strategy were I not convinced that there is a better strategy available.

Roger Penrose is I think as convinced as Atkin, Bastin, and Kilmister that there is little hope of real advance so long as we remain wholly within the restrictive framework of current physical ideas, and he too feels that the backcloth of continuous space-time is one of the first features we should try to jettison. But in his paper, "Angular Momentum: an Approach to Combinatorial Space-Time'," his strategy is not that of trying to rediscover all physical theory from scratch but rather that of taking that part where discreteness is most evident and trying to reformulate it in such a way that the discreteness occupies a quite fundamental position in the theory and continuous concepts only emerge in the limit of complicated systems. The beauty of Penrose's strategy is that because he is simply reformulating part of orthodox physics his theory can at every point claim the evidential support which is already provided by the successes of orthodox physics. But nevertheless because of the radical character of this reformulation it is fully capable of providing deeper and more intuitively satisfying explanations of some aspects of the universe. For the explanatory power of a theory depends on the details of its deductive structure and not just on the class of theorems which it yields. Thus the three-dimensionality of space is a theorem in Penrose's theory and there is no reason to suppose that any merely minor modification of his basic assumptions could yield a different dimensionality. Of course it could happen that Penrose's theory will eventually be developed in a way which will lead to some consequences different from those of orthodox physics. This would happen if it turned out to suggest the plausibility of some principle which was consistent with observations but inconsistent with orthodox physical theory. The history of physics presents many examples of this type of successful innovation arising from what started merely as a reformulation of an accepted theory (Maxwellian electrodynamics is perhaps the best example). However such a development is not presently the main objective of Penrose's theory. He is rather attempting to reconstruct as much as possible of present physics, that is to say of its successful parts, within the new framework, by appropriate reformulation. The question whether, as one would hope, one can reconstruct curved space-time within this framework is exceptionally interesting as well as difficult. The present form of the theory is also rather inappropriate for treating particles of other than zero rest mass. Penrose is more optimistic than I am over the possibility of building up finite rest mass particles from interacting zero rest mass ones. But he may well be right in thinking of zero rest mass particles as in some sense more fundamental.

Since the aims of the theory are to explain both space-time and quantum mechanics it is interesting to consider how such a theory might possibly resolve the basic measurement paradox of quantum mechanics with which I started. In Atkin's and Bastin's approaches the observer enters essentially and they obviously hope that this will have some relevance to the measurement problem. But the observer plays no role in Penrose's approach and he is thus committed to some completely objectivist solution. His basic picture would allow us to say that in many situations reality is objectively less determinate than is its artificial representation by means of our conventional space-time language. On the other hand he does not seem to think that it is always as indeterminate (before we actually look) as conventional quantum mechanics seems to say it is. Thus Penrose thinks of the probability of a particular outcome of a creation, collision, or decay process as a measure "in some vague way" of the frequency in the history of the universe of occurrences of processes with input-output relationships of that particular kind. Such frequencies are to be calculated according to simple combinatorial rules which Penrose specifies. This picture corresponds to the objective view of events in the microscopic domain which every physicist adopts when actually in the laboratory. But it is not the picture that orthodox quantum mechanics requires us to adopt, for according to the latter indeterministic processes occur only in the context of measurements. How it will be possible to replace this obviously unsatisfactory picture by one involving indeterministic aspects of a more objective kind, as in Penrose's theory, without actually violating any prediction of orthodox quantum mechanics, is to me still a puzzle.

Jon Dorling

Comment: Dowsing

Messrs. MacMillans have kindly sent me a copy of *Theoria to Theory*, Vol. 5, April, 1971, and I have read your Editorial with considerable interest. Unfortunately, I did not see your report on an interview with Colonel Merrylees.

Many dowsers of experience expressed the view to me that the art of dowsing can be learnt and that it is analogous to playing the piano. Practice improves performance, but clearly some people are more gifted than others. Colonel Merrylees set out to select young officers who had dowsing sensitivity which he did in the manner I have described in my paper. At the first alleged subterranean flow, Colonel Merrylees forecast by dowsing that water would be found at a depth of 156 ft. A boring to 230 ft. was made – a generous overlap beyond 156 ft. No water was found. In my view this counts as a dowsing failure. Colonel Merrylees then revised his estimate to 400 ft. but the boring was discontinued. Clearly revision of estimates could go on ad infinitum.

Thus his assessment of the sensitivity of the Officers which he graded "marked", "high", "useful" and "nil" was purely subjective. Nevertheless the 25% who were graded "marked" and "high" carried out a subsequent test as described over a known water main. 20% of these high graded officers were now found to have nil sensitivity. To my mind this casts doubts on the initial grading.

I question the vast literature of successful experience. Dowsers are only human and tend to record their successes more often than their failures. M. Rocord had at least carried out some experiments and put forward a theory to explain.

I do think you have parodied the position. A scientific experiment should have a purpose and that is to discover a bit of truth. The arrangements for the trials were discussed with many dowsers who agreed they were fair.

I am an Engineer myself, not a scientist, and had an open mind throughout the tests. I should have been delighted to find even one dowser who could substantiate his claim in a significant and demonstrable manner.

R. A. Foulkes,
Director – Engineering Division,
Industrial Research Centre,
Ballymun Road, Dublin 9.

[Colonel Merrylees writes: —

"I only use the music analogy with great reservations as I cannot accept that an ear for music and the dowsing sensitivity are similar.

Actually the choice of flow for the drilling crew under instruction was independently selected to suit the drillers. I have always to admit that I am most uncertain about estimating depths, which was why I gave 'the bottom of the upper chalk' in this case. As far as I can remember the figure of –230 feet was an attempt to extrapolate from a rather distant section on a geological map. The fieldworks ground is on a clay ridge but chalk is shown on the 'solid' map round Cliffe about a mile north of the bore site.

Mr. Foulkes was surprised when novices, after testing on natural flows, but with no other experience, failed to find a pipe. If he wants to use the music analogy, would he consider that a musician, trained on a piano, was a failure if he could not, without any practice on it, play a violin?

I would like to recommend to Mr. Foulkes the book 'The Divining Rod' by Barrett and Besterman."]

Sentences

What is so confusing about us is that we are at once the Pharisee and the Publican.

* * *

It is very dangerous to go into eternity with possibilities which one has oneself prevented from becoming realities. A possibility is a hint from God. One must follow it. In every man there is latent the highest possibility, one must follow it. If God does not wish it then let him prevent it, but one must not hinder oneself. Trusting to God I have dared, but I was not successful; in that is to be found peace, calm and confidence in God. I have not dared: that is a woeful thought, a torment in eternity.

* * *

Most people really believe that the Christian commandments (e.g. to love one's neighbour as oneself) are intentionally a little too severe

– like putting the clock on half an hour to make sure of not being late in the morning.

* * *

The Two Ways

One is to suffer; the other is to be a professor of the fact that another has suffered.

The first is "the way"; the second goes round about (the preposition "about" is so aptly used for lectures and sermons) and perhaps it ends by going down.

* * *

It is not always grave suffering that is most likely to help one to die to the world. No, that can also give joie de vivre, *spiritual* joie de vivre. *No, the most deadening things of all are worldly hardships, mere trifles.*

Stoicism was really profound. It only allowed suicide in this case. It does not allow suicide as a method of avoiding great dangers, how should it do so! But in case of something deadening, spiritually deadening, it was allowed, for here there was really nothing for the "spirit" to do.

That is precisely what Christianity has in mind. Where Stoicism would say: now you have the right to kill yourself – that is precisely where one can die to the world – if one is to endure living on.

* * *

It requires moral courage to grieve; it requires religious courage to rejoice.

From "The Journals of Kierkegaard", translated by Alexander Dru (Oxford University Press). Quoted with acknowledgements to the translator and publishers.

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