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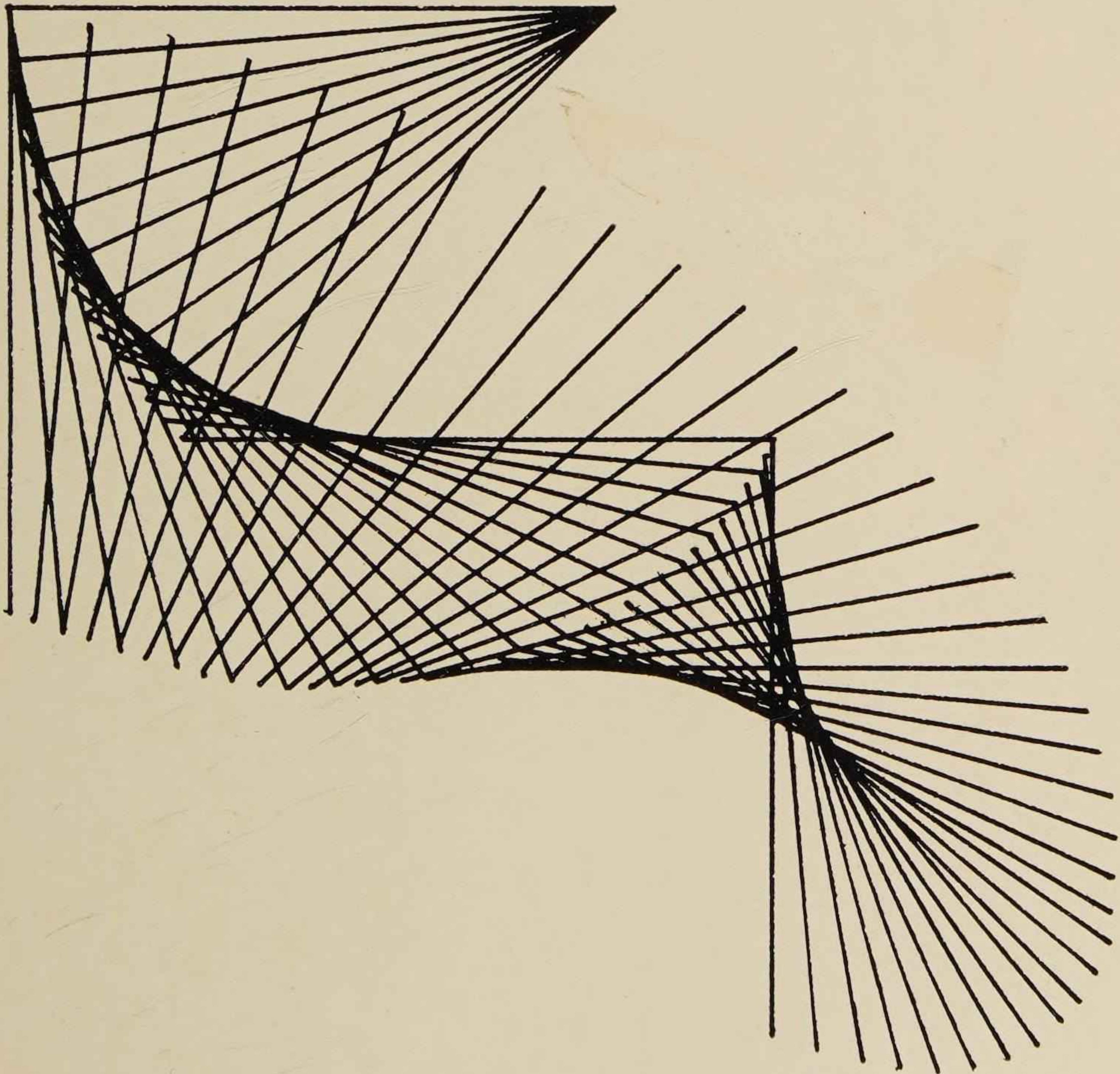
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THEORIA to theory

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Editorial

In this number we have a meditative piece by a poet, William Davis, on a book by another poet, Daniel Berrigan, who is an American Jesuit. Daniel Berrigan, like his brother Philip, also a Catholic priest, is in prison for pouring blood on draft cards and setting military draft files alight with napalm as a protest against the Vietnam war. (See our review article in T. to T., V iii, July, which included Philip Berrigan's "Prison Journals of a Priest Revolutionary" in a group of books by different elements of the new radicalism in America.) These brothers are in the line of a long tradition of Christian conscientious objection; but whereas most conscientious objection has taken the form of refusing to do something publicly required, they have seen the power of making their protest through a public ritual action.

Discovery of the power of ritual is characteristic of the new radicals. The sit-in is a stylised form of behaviour, not just an unruly obstruction; so too are the marches and the rhythmic shoutings. More imaginatively, protests against the rituals of established society are being made through staging counter-rituals. These are rituals of rebellion, occasions for letting out frustrations, guying authority, showing what things look like when roles are reversed. Sometimes they are part of a political campaign. The bomb plantings of the Angry Brigade are more like ritual acts designed to shake people up (rather literally) than like acts of political assassination. They are, however, a dangerous kind of ritual act which can get out of hand. The bombs are too big. Most of us probably started out by feeling nothing but indignation against the Angry Brigade. But reading the account of the recent trial of Jack Prescott and Ian Purdie, on the charge of planting a bomb at the house of the Secretary for Employment, made us see that there was at least a moral problem here. When people get a desperate feeling that those at the top of society are not listening, they may turn to violent acts as a symbolic way of calling attention to what they want to say. (The bombings and shootings of the I.R.A. are not meant as symbolic acts, as ritual protests; they are meant as realistic acts of war.) Moreover, Jack Prescott had drifted along miserably as a criminal until he came across the Angry Brigade, where he found for the first time friendship, support and a purpose. Both he and Ian

Purdie were acquitted on the charge of actually planting the bomb at Mr. Carr's house, but Jack Prescott has been given 15 years for illegal conspiracy. "Conspiracy" is a very wide term. It may mean actual planning, or it may mean taking part in excited talk. This vagueness is important, since Philip Berrigan along with a number of his friends is facing further trial on a charge of alleged conspiracy to kidnap Henry Kissinger (Mr. Nixon's representative on Foreign Affairs) and to blow up the heating system under Government buildings in Washington. Again, we wonder whether, even if these actions were being discussed, they were not being thought of as possible ritual acts of protest rather than as attempts to hurt or kill. A kidnap to extort ransom, or accompanied by threats to kill, would not be a ritual act. If this kidnapping was being envisaged, would it have been like that? The line may be difficult to draw, and, as we have said, the ritual which uses dangerous stage properties may get out of hand. But the people who use violent rituals are not thugs. They repudiate the ordinary give and take morality of everyday social life, but they have something of the sacrificial morality of people following an absolute call. This is why it takes someone like a saint, and not just a liberally minded person, to reach them (Ian Purdie's mother, who seems to have been the one person who really cherished these young men and tried to win them from violence, may have been such a one). Even where ritual violence of protest turns to actual revolutionary violence, there may be a sacrificial spiritual elation, since people know they are just as likely – in fact more likely – to be killed as to kill. The trouble is that if they are successful they see their violence as justified and may go on using it fanatically and to oppress in turn.

If not only militant revolutionaries, but also to those who use violent rituals of protest, are not to slide into callousness, they will need to be people who have a contemplative side. Perhaps in the end these are the only people who can be trusted with such rituals. This is where the Berrigans are again important, and William Davis' piece shows this. (It also shows that not all "drop-outs" are following various kinds of Eastern religion. There are also Catholic ones, who use Christian imagery to express what they want to say.)

If violent rituals can get out of hand, non-violent ones can go the opposite way and become stereotyped. A crude social

psychology just sees ritual as stereotyped behaviour. There is indeed a ritual man in all of us. Erving Goffman (see for instance "The Presentation of Self in Every-day Life" and "Interaction Rituals") and Richard Hoggart, in his current Reith Lectures, describe how many of our social conventions and manners are in effect ritual games which we play with each other. Much of Goffman's material comes from studying people in asylums, but what we all do outside asylums is not so different. We meet ritual actions with other ritual actions, often in order to preserve our privacy from intrusions. The editor remembers an occasion when a High Church curate on being introduced to the then Bishop of Oxford, Thomas Strong, knelt down and kissed his ring. Strong was not used to this kind of behaviour, and he rejoined with "Nasty day it's been, hasn't it"? Remarks about the weather (in England, not in countries where it happens as expected) are ritual moves in small talk, where encounters can be mildly friendly without becoming "I-Thou". They can of course prevent more interesting communications from taking place. It is possible that the young man was hoping to establish a "father in God" relation with the Bishop.

Can ritual be used so that it is not a stereotypy or a defence, but provides a framework of communication within which something that matters can be conveyed? William Davis is so conscious of the stereotypy, the drag towards inertia, in nearly everything that we ordinarily do and say that he sees the alternative to tagging along as *silence* – silence as a condition of "being" in which we can rise above the inertia of time and the pressures to conform, and in which we can save ourselves from disintegration by finding unity with the source of life. He believes that if you are silent you may in the end come to know what you ought to do.

Silence can mean, among other things, getting to a state where we can really listen to each other. So it can feed forms of common life in which people do not feel pushed around, but can play their roles in ways in which their own characters count. Monasticism was originally designed to provide a framework in which silence fed into creative work, but Thomas Merton (our friend in T. to T. whose disciple William Davis is) saw that it was losing this genius. He was concerned with how there could be groups with this quality of life outside as well as inside monasticism. So too are many of the drop-outs.

They see our public society as a dying rather than a going concern, and they express their sense of the end of a civilization in a spirit of eschatology rather than of *fin-de-siècle*. (Daniel Berrigan's book and William Davis' meditation on it is about "Apocalypse.") *Fin-de-siècle* is a civilised attitude but a disillusioned one. These new eschatologists have vitality and are looking forward to something that may come. If meanwhile they are withdrawing into silence and forming groups outside the run of the world's work, this is not so unlike the flight to the Desert in the 5th century. Perhaps there must be people who do something like this in times when one world is dying and another is struggling to be born.

The drop-outs and radical protesters are people of great courage. They have succeeded as no one else has in shaking the assumption that what really matters is individually to get on in the world, and collectively to achieve economic growth. They can be overtaken by the pressures to conformity endemic in all groups, including their own. Or they may resist this. The future forms of social life may well depend on the possibility of there being groups which can combine the adaptable efficiency of the *kibbutzim* in Israel, which very well understand the value of good technology, with the concern for privacy and inner life and a chance "to do your own thing", which is what the drop-outs care about. Such a combination would have a double source of adaptability.

Which brings us back to the drag to conformity in social groups in general and in ritual in particular. Kathleen Russell (one of our contributors – see for instance T. to T. V. ii), who is a teacher of ballet, speaks of a "constrained spontaneity". This sounds a contradiction; she means that in ritual moves people can be so in rapport with one another that if anyone breaks out in an individual way, it does not disrupt, but the others meet it positively. Here a ritual can be the opposite of the obsessive way of maintaining defences that social psychologists say it is.

This creativeness can happen if a group can come to take its rituals, if not lightly, at any rate as a dispensable part of a wider enterprise, either of the group as a whole or of its members with each others' support. Contemplation – thinking (really thinking) – hard work – these can all count here, and some of the drop-out groups know it. Gandalf's Garden off the King's Road Chelsea features in a *de haut en bas* article

“Route Maps to Salvation” in the *Guardian* (December 4th). When you have kept a centre going on a shoe string as long as some of its members have, and when you have sat up at night as often as some of its members have with your neighbours who are trying to come off drugs, then you can criticize its “ear-ringed” young men.

* * * *

The “Theoria Association” (by whatever name it is eventually called) is beginning to be a kind of invisible college of collaborators in the background thinking needed for T. to T. We are looking for funds to give it more definite form.

The notes following this editorial indicate the possible religious implications of a more general project we are taking up, of looking at the criteria which can be used in trying to assess “way-out” research.

* * * *

Our cover was designed by Zette Barron. It represents a movement which starts in the top right hand corner; each “fan” moves at twice the rate of the previous one (shown by increase in size, so that the third “fan” is four times the size of the first). This way of generating curves to represent movements originated with the Eshkol School of Choreography (see *Biological Computer Laboratory Report 10.0*, University of Illinois). Zette Barron is an architectural model-maker, who is now bringing up a young family and is involved in teaching construction at a Midlands art workshop for children.

The Case for Way-out Research

*Dorothy Emmet, Margaret Masterman,
Ted Bastin, Robin Monro*

Recent press discussions of whether one should be a Christian or a humanist, and whether one needs to believe in God, seem to be shifting from being matters of philosophical argument to becoming matters of sociological fashion. Thus in an article in *The Times* Alistair Kee says that belief in God is a cultural matter (indeed that it goes along with a "flat earth syndrome" and that such believers as remain today suffer from "cultural schizophrenia").

This line is developed further in his recent Penguin "The Way of Transcendence", which has become a best seller. We are told the Death of God lasted from 1963 to 1967, not with the implication that since 1967 God has come to life again, but with the implication that to be interested is no longer in. How fashion-ridden can one be? Presumably we are to decide where we stand religiously not on what is true, but on what is congenial to think in the present cultural context.

This thesis is false. There is an alternative to being fashion-ridden. Granted, our thinking, our language, our forms of expression are deeply affected by current attitudes and social conditions. Nevertheless, there can be enquiry which is not merely congenial within a cultural context, but which is one people coming from different backgrounds can learn to appreciate as a way of making true discoveries. For *Science* is not just what people within a certain circle agree to say at any given time; if it were, they would not be able to use it to get to the moon, or cure diseases, or put up buildings that do not fall down. (That some do fall down underlines the fact that we take it for granted that most of them don't.) So we have this one example of a way of thinking which represents a gigantic, cumulative effort, however fragmentary and however faulty, to discover what the world is really like.

This of course is disputed by those who say that science also runs in sociologically conditioned fashions, the reference group for the fashion being what people doing science in a particular cultural context choose to say. Those who talk like this find

reinforcement in selective quotations from Kuhn's "Structure of Scientific Revolutions" (see Vernon Pratt's review of *Criticism and the Growth of Knowledge* later in this number) and from Michael Polanyi's *Personal Knowledge*. But to talk as though all fundamental scientific advance were thus fashion-ridden is to concentrate on what may be called its "persuasive" as distinct from its "revisionary" aspect. By "persuasive" moreover we mean not just what Kuhn means by "normal" science – i.e. the vast mass of problem solving research that goes on using existing paradigms and recognised techniques. "Persuasive" science is likely to be this too, but it is not only this. Or rather, we are using this word to emphasise one aspect of what Kuhn says about "normal" science. This is where normal science is not just a methodological approach but a view with philosophical implications which is treated as an orthodoxy: an instance would be "central state materialism" as the only permitted way of thinking about the brain. "Persuasive" also carries the implication of getting something across, the typical embodiment of which is the text book and set course of laboratory teaching, where experiments are set up not to discover new truths, but as *demonstrations* of something to which the answer is known. And if they go wrong you try again.

"If you get a blue precipitate
Which the book says should be pink,
You wait till no one's looking
And you throw it down the sink."

There are also the genuine experiments where the answer is not known and where *verification* is crucial and these of course occur in "normal science". (Kuhn indeed, by emphasizing the persuasive aspect of "normal science" does not sufficiently bring out that nevertheless it has both verification and falsification inside it). Occasionally there is more even than this, an even greater element of innovation, of surprise, and here we have "revisionary" science. This, again to refer to Kuhn, is not just his change of paradigm as a new *Gestalt*, a new way of organizing how the facts are seen. It is something far more fundamental which may manifest itself, as Kuhn says, in a *Gestalt* switch of mathematical vision, but may consist in the sudden intuitive adoption of a new key analogy. The point is that once a new step has been taken, all the mass of obvious experimental evidence which fellow workers are accumulating has to be

abandoned. It feels as if one has to distrust one's senses; all one has to cling to is a bare chain of argument, mathematical or analogical, which, instead of being ancillary to a constant process of direct empirical verification, now has to do instead of it.

So far, revisionary science seems indistinguishable from trying to do revisionary metaphysics, but there is one vital difference. In revisionary science there has to be some chain of argument, however long or indirect by which connection is made between the new analogical picture or mathematical system and what is agreed by all practitioners of the science to be some one key fact or set of facts. If the new system explains this, it will as well explain all the mass of simpler facts which its creator initially had to ignore. If it does not, the new revision collapses *in toto*, because by definition there is no other fact with which it connects at all.

This contrast of "persuasive" and "revisionary" science is analogous to but not identical with the distinction which Strawson (see his *Individuals* p. 9 ff.) and others have drawn between "descriptive" and "revisionary" metaphysics.

"Revisionary science" may well however start out not unlike a piece of revisionary metaphysics. This is not so likely now as in some periods in the past, since our few would-be revisionary metaphysicians such as J. N. Findlay or Heidegger, are not in touch with the growing points and strains in contemporary science, as were, for instance, Descartes or Leibniz in their day. But the first stage of the revisionary scientist's vision may be more like metaphysics in helping us to see why e.g. Descartes or Leibniz or Whitehead wanted to say some of the things they said. Yet it cannot simply be a matter of trying to say something of this kind better, on a very general level. The revision must in the end produce some key fit with some key facts – an experimental, verificatory enterprise which, however indirectly, will test the revision, and also show whether it blocks further lines of inquiry or opens them up.

All this – the need for even "way-out" revisionary science to be involved in the struggle to find verifications or falsifications – pulls scientific innovation, but its very nature, out of a purely culture-bound context.

All this being so, what about theology? Is any theology always a part of some particular culture-based fashion, or is there any sense of "theology" in which it could be thought of as a way

of finding and presenting truth, as indeed is often said? In its great ages, "theologia" was wisdom which came through mystical experience, and it was expressed in a philosophical tradition which owed much to Platonism as well as to Hebrew prophetic insight. But even this did not achieve the combination of vision with testing which could drive it forward into a universal, trans-cultural, "revisionary" way of discovery. It settled back into being "persuasive". And as frequently practised, it seems to be acquiescing in cultural conditioning instead of struggling to break out of it. The Barthian theology, indeed, was a heroic effort to break out. "The Word of God" was a revelation which could be equally at home in all cultures and in none of them. This was splendid; but as soon as anything more was said about the revelation it sounded very Germanic.

The other objection is that it is increasingly difficult to say that theology gives us *knowledge* of the world (in the old broad sense of "world" as "cosmos", "universe", not just "mundus,") as distinct from poetry or recommendations to a way of life. There may of course be truth expressed in poetry, and theology as "theoria" has traditionally been connected with ways of life (see T. to T. I, i). But unless it is possible to say what the truth in the poetry is, or show how the way of life is connected with a true vision, people become cynical about theology. Poetry, they will say, like patriotism, is not enough; or, if we are only being given moral policies, why not just take them humanistically? Further, if there is no more than this in theology, and it is so rapidly liquidating itself, why should anyone be paid to teach it?

So a lot of people are saying that we cannot go on like this. We want truth, and it looks as if the way to it must be through a metaphysical out-thrust which so relates to experience as to be more than intellectual imagination. But if there is to be genuine intellectual vision, which can be submitted to testing, then we are asking for revisionary science – revisionary science which brings awkward facts taken from deep mystical experience to the notice of disbelieving scientists.

People with this concern can have had either a literary or a scientific education; their worries are not the same.

The arts man sees science and technology becoming more and more powerful and encroaching more and more upon his life, both outwardly and inwardly. He does not fully comprehend the nature of science, but he knows that, in spite of the arrogant

claims put forward by some scientists, current science is not adequate to answer the questions he wants to ask. But most scientists will say that these are just the questions whose investigation never yields any real, firm science.

The scientist's worries are partly ethical, over the social effects of science. But more deeply, he does not see how to relate the apparently soulless universe of science to his own personal life and experiences; to beauty, love, death, including perhaps paranormal or mystical experience. Faced with this situation, the scientist then tends to search for ways of bringing other aspects of his experience into relation with what he thinks in his own work. He becomes particularly interested in anomalies arising or existing within the structure of science, since these act as clues as to where changes might come in a general view which he has always assumed to be coherent. He may be worried about paranormal phenomena, especially if these have occurred in his personal experience, but in most cases he refrains from making this concern the subject of his work because it clashes too fiercely with the current line of persuasion in science.

The arts man, by contrast, precisely tends to seek out and confront the scientist with phenomena that produce incoherences with current science. It was arts men – largely philosophers and classicists – who founded the Society for Psychical Research, and only later, with considerable pushing, did a few scientists become interested. Today there are perhaps equal numbers of arts men and scientists interested in “way-out” phenomena, but the emphasis still remains different: the former prefer what the scientist calls anecdotal evidence about monsters, ghosts, out-of-the-body experiences, while the latter, when interested at all, are more concerned with the analytical aspects of ESP, psychokinesis and precognition.

Into this complex situation, with the arts man trying for one kind of thing and the scientist trying for another kind of thing, comes the current development of a “counter-culture”; an upsurge of people who see science as a threat to their inward lives and to their outward environment, so that they develop an anti-science hate. (See Theodore Roszak, who describes all this sympathetically in *The Making of a Counter Culture*.) They are not right from a moral and practical point of view, because (unless they are prepared to let most of the population of the world die, and themselves, if they are lucky enough to survive, to go back to scratching for peanuts) they will in fact

live on and by the results of modern technology and modern medicine. They are also not right intellectually and spiritually. For if the religious man or the arts man in the end wants truth, he will not reach maturity unless he can come to understand what truth is like. He need not necessarily become a practitioner of a particular piece of science, but he must make the effort to understand the character of the scientific enterprise. So must the scientist. Far from being a tyrant, the scientist is currently in a serious predicament. He is being attacked for reasons he doesn't really understand: he is engaged in a sophisticated enterprise the nature of which he doesn't really know, but which often leads him into considerable sacrifices, fatigue and danger. As well as this he is a member himself of that same human race whose history and moral aspirations and religious institutions he is professionally refusing to enter into.

Supposing he takes notice of criticism (say by Rozzak) and becomes willing to look at the whole matter with new eyes. What should he do? It is evident there is nothing to help him in the publications of the sociological theologians, for these have abandoned both all serious search for what is right and wrong and all serious struggles for truth. As he will see it, there is no help for him in any religious tradition or any church.

So what can he do? He can occupy himself in trying to mitigate some of the worst social evils caused by uncontrolled applied science. However in the end this is a peripheral activity. He has to get to the heart of the matter and try to get a better understanding of revisionary science itself.

If he does this, and if he considers the origins of revisionary science, and the analogy of revisionary science with revisionary metaphysics, then sooner or later it is going to hit him that the picture of the deep structure of the universe as it has been given by the great mystics both east and west, is the most profound and far-reaching piece of revisionary pre-science that he is ever likely to see. Moreover, it is the piece of revisionary thinking which the human race itself (of which he is a member and to which he owes a duty) in the end cares most about, because it is the source from which all these forms of thought in fact flowed. However, the great mystics of the world never turned their revisionary thinking into *science*. Nor did the churches or priesthoods or monastic orders. All that they did was to try to demand belief in their version of the mystical picture by assigning to sets of statements or dogmata a quasi-legalistic

status. Creeds became like laws.

Only Christianity, queerly enough, did attempt a process of scientific proof of the truth of the picture by connecting it with the detail of one particular life – namely that of Christ. But from the full scientific point of view this method of proof by single exemplification has a kind of lunatic feel about it. For what the human race urgently needs to know is not primarily the truth about Christ but the truth about all men, in so far as the mystical picture gives a true account both of their potential and of the nature of the whole universe.

So the staggering, overwhelming task which confronts the awakened scientist is that of turning this greatest of all revisionary pictures into revisionary science, and of bringing it to verificational test. It is here and only here that all the varieties of activity which would commonly come under the term “way-out research” are included. After all, in so far as he is only pursuing his own specialist professional activity, why should he take any notice – say – of parapsychological facts? The first professional duty of any scientist is to make his own professional line go right – not to ponder on the total nature of man or the total nature of the universe. He will be well aware already that there are cardinal discontinuities inside science, that, for instance, quantum theory does not fit with molecular biology, nor depth psychology with physiological psychology, and anomalies will almost certainly arise as attempts are made to interrelate them. But it is no part of his ordinary duty to dwell on these (the trouble is that it is no part of anybody’s ordinary duty to dwell on them); the scientists aren’t philosophical enough, the philosophers don’t want to know, and the so-called theologians have blown inside out like an old umbrella.

But thinking about anomalies in existing science, though this is relevant, won’t of itself enable him to re-envisage scientifically the revisionary mystical picture. He has got to make this picture connect more with some facts than with other facts, and this means that both he has got to revise and enlarge his conception of physiology, human in particular, in accordance with the new “theory”, and he has got to investigate the existence of the primary phenomena which the mystics of east and west have said do exist (as did the rest of the world until recently, but which the modern scientific materialist world, under the influence of another paradigm, says don’t exist). Everything from telepathy to psychic healing, from dowsing to divina-

tion. In this investigation, he has not to let himself be carried away through hallucination, trance, or any other kind of exaltedness. He has got to remain throughout a real scientist doing real science.

This, at last, is where the religious people, and especially the Rozsaks and the modern mystics and contemplatives, can come back and help him, by being cognisant of what his task is and of what he must do, and by being prepared to submit their experience and faculties to test. It wouldn't hurt them either to do some parapsychological science, or for the doctors among them to tackle the problems involved in enlarging physiology. Once the religious people have come in experimentally, the philosophers can come in also.

What does all this come to philosophically? For philosophers who have accepted the necessity for this gigantic conceptual revision and upheaval, what comes next? We see that we have come to a point where a massive revisionary change is being called for, not so much in procedures for particular pieces of problem solving within science (though in some cases this too), as in fundamental orientation. It would be tempting to say that this would mean abandoning the "materialist" basis of science, if it were not that the meaning of words like "material" and "spiritual" is itself philosophically breaking down. With the old labels failing us, our philosophical-cum-religious act of faith has got to be that through science itself we shall come to see that some of what traditionally were called "spiritual" experiences, if they exist at all, are not just epiphenomena, but part of the out-thrust through which we hope to discover what the world is fundamentally like.

Discussion: The Organization of Cells

Two members of editorial group (A and B) talk to Irene Manton, F.R.S.

A.

There is a puzzle which you – as a cytologist – might be willing to help me clear up. An engineer, or a physicist, trying to understand a living organism would probably find the biologists' procedure unnatural in that the biologist seems to unravel a lot of different mechanisms in the certain faith that there is an underlying controlling system which gears them all together. The engineer – by contrast – would expect to get some idea, first, of the overall basic functioning of the system and then he would be able to assess the significance of the bits. If he worked the other way he would be quite likely to make gross mistakes about the subsidiary mechanisms – getting, for example, ends and means to ends in quite the wrong order. Now of course the engineer will appreciate that whatever the cytologist might like, he does what he in fact is able to do; nevertheless, the logical point remains, and I suppose the application of it might be to suggest that cell biologists might be a little more self-conscious about the overall assumptions about organization that are guiding them – most of all perhaps when they think that they are not being guided by any.

I.M.

Well, if by clarifying one's assumptions you mean setting up a working model, you have got to be very careful indeed when you start setting up models in biology. I remember very well the situation before the electron microscope when the cytoplasm was assumed to be *unstructured* colloid. It looked like that in every way and everyone assumed that that was how it was: it was just protoplasm, and very mysterious of course. Now if anyone then had been setting up general models (and there were some who did) they would have thought of all sorts of things but never have questioned the one assumption that was vital, and vitally wrong: namely the uniform-fluid (colloidal sol) character of the cytoplasm.

A.

But wouldn't it have helped if they had written down explicitly

that they were assuming that? Wouldn't that have prompted them to check up experimentally, seeing that that assumption was so important?

I.M.

It certainly was important, but the problem was *how* to check up experimentally. One had in those days, the knowledge that a vast array of different complex chains of reactions were all going on in the cytoplasm, each with its own rate controls, with often mutually incompatible reactions, going in opposite directions simultaneously to give different products, all apparently without mutual interference. When we discovered that the cytoplasm is separated by definite boundaries into regions the whole picture together with its puzzles changed. It is now known that certain reaction chains are segregated from others within membrane bounded compartments. The importance of membranes within the cytoplasm had not previously been visualized.

A.

Yes, that is a superb case which brings up the difficulties of imagining the overall control inside the cell very well. I see the case against premature speculation too, but I still sense that the cell biologist is more liable than he should be to slip into feeling "I know what the component processes are and I know that they all co-operate to produce a cell which is a going concern, so I must have understood the cell".

I.M.

I think you exaggerate the cockiness of biologists in claiming understanding and you are certainly yourself under-estimating the enormous complexity of a biological entity as large as a cell. I don't think anyone has ever claimed to understand a cell in its entirety since as you said earlier little bits of understanding have to be pieced together stepwise and there are always plenty of unpieced bits behind those that have yielded to treatment. It is true however that before the advent of electron microscopy people underestimated, and therefore tended to ignore, the vastness of the region of space lying below the limit of resolution with the light microscope but above the level of atoms and molecules studied by chemists. X-ray crystallography bridged the gap a little but for non-crystalline structures there were very few direct methods of approach. Few people can have

expected to find the vast numbers of complicated and varied objects which we now know from direct experience to be present both inside and outside cells in the space which to the light microscope appears optically empty. An early example known to me came in 1941 when Tobacco Mosaic virus particles were seen for the first time with a relatively primitive electron microscope in America. This was extremely exciting then because it showed by actually seeing a thing, that particles miles below the limit of the light microscope *were* the same general shape as had been inferred from X-ray analysis. They were rod-shaped things, and the width was about right though the length was very varied. That was the start of electron microscopy applied to an actual problem (as opposed to testing the microscope).

A.

You are making a sharp distinction between seeing and inferring.

I.M.

Yes. The Bragg type of inference applied to tobacco mosaic viruses (T.M.V. for short) had shown that they were rod-shaped particles of a certain calculated size. Whether the size was worked out by X-ray analysis alone or by X-rays amplified by other techniques such as centrifuging I don't know. But the tie-up with direct vision was a major advance scientifically and extremely exciting.

That in itself didn't bridge the gap between the cell and the molecule, and of course there are other gaps, because work which has happened since has analysed the structure of T.M.V. rods into a most elegant architectural arrangement in which almost every molecule and atom is now located to a place: it is known that the apparent rods are hollow tubes and that there is a spiral winding of nucleic acid inside the tube. The body of the tube, in fact, is made of a spiral winding of proteins of such and such a kind arranged in a very precise way. The analysis of viruses has filled in a region of space between the molecule and larger things, but there is still an immense gap between that and the cell.

B.

I come in as a philosopher with an interest in morphology.

Philosophers since Plato have always tried to find in Nature something that could be a microcosm of a larger macrocosm. Now the candidate par excellence for this is the cell because, with the current support mechanism idea, it is supposed that every cell has everything, but that some of its potential is suppressed when it combines morphologically with other cells.

Now, from what you have seen, is the cell big enough and rich enough potentially to act as such a microcosm? This puts the whole universe into the cell. But this is the sort of way that molecular biologists are now talking – without realizing they are just being Platonists.

I.M.

I would be reluctant to express views about the whole universe. I don't quite know what is meant by "the whole universe".

B.

Well, say a whole organism.

I.M.

Yes, except that the organism can emerge.

B.

Doesn't the cell emerge?

I.M.

That is an entirely different topic. There is the inherited substruction which changes only in minor ways from one generation to another and of which, as you say, various bits are suppressed. Your muscle cells, for example, and your hair cells and your eye cells all have the same total overall potential but only certain bits are allowed to function in certain circumstances.

B.

Of course that is a theoretic hypothesis, because you can't see with an electron microscope the information that's not being used.

I.M.

Indeed you can't, but the whole of cytogenetics does provide a very convincing body of knowledge that the information, which is carried by the nucleus and distributed equally by

mitotic arrangement to all cells (and then there is reduction-division and sexual fusion), is the information which carries what the situation requires for reproducing this pattern in the next generation. I think that the evidence for that is quite above board.

I may be not up-to-date in what happens if you transfer nuclei from one organism into another – say you put a nucleus into the wrong cytoplasm – but it does look as though the main information is in the nucleus and that the basis of information is the genetic code and it is made of DNA.

B.

I wasn't querying that; what I wanted to lead you on about was this:—supposing you could get another order of magnification somehow in what you actually observe in the cell, or another way of going much smaller, then what would you find next?

You accused the people who came before the electron microscope of lack of imagination. (They hadn't begun to imagine the beauty and complexity that was really there.) What next? I am interested in information – a sickening thing to be interested in.

I.M.

Imagining the unknown is always difficult and usually impossible so that I don't blame my predecessors for what they hadn't thought of. For the same reason I can't attempt to tell you what the region of space below our present limit of visibility will contain, or rather, what it will look like if and when we get down to it. I can only point out that the space available to be filled in is still quite large. There is a gulf between the DNA and the chromosome to start with. I am a cytologist and I have spent half my life studying chromosomes and there are certain things that you study in chromosomes that you cannot yet see with an electron microscope. There is space inside a chromosome for a vast amount of substructure; and that is the least successfully explored part of cells because for some reason the techniques that have yielded results up to now have been more satisfactory with other parts of the cell and least satisfactory with nuclear contents. So that chromosome structure is still a thing where direct observation with the electron microscope has scarcely added anything to what

you knew already with the light microscope. The electron microscope helps most with the lighter parts – the cytoplasm.

A.

The opposite of what you'd expect.

I.M.

Absolutely the opposite. I started life as a chromosome cytologist, and when I began teaching a course in cytology I always started historically. I also felt, "well dammit, you've got to do something about the cytoplasm", and I think I gave one lecture to the cytoplasm – as this very viscous fluid – mentioning its viscosity etc. etc. I certainly gave no more than one to the other parts of the cell – chloroplasts, golgi, mitochondria and the mitochondria and the golgi were very suspect. I remember when I was in Cambridge as an undergraduate taking part in a debate where the general consensus of opinion was that these particles which microscopists said you could stain up with Janus green were probably phoney; and now it's that bit of the cell which has expanded into a term's course.

B.

What about the nucleus?

I.M.

Speaking as an electron microscopist (and not a molecular geneticist) there is some splendid new information from direct observation of the nuclear envelope (which was also suspect – was it just an optical line? was there a membrane round the thing?) but there is singularly little else in an ordinary nucleus that you can't see just as well, or even better with the light microscope, because with the light microscope you can put differential staining so that different bits can be coloured up. You can't do that so much with the electron microscope.

A.

What are the conditions you work under with the electron microscope? Presumably the cell is very dead.

I.M.

Yes, but you see ordinary cytology is in the same boat; you can't (except sometimes with the most recent and sophisticated

methods) avoid dealing with killed and stained material. There have been most elaborate parallel series to show that the method of the killing is not introducing something gross (at light microscope level). This is perfectly clearly understood and no-one is worried about it with the light microscope because you reach the limit of resolution at 2000 diameters, and you are certainly not introducing gross distortion down to that size. Of course below that we may be totally removing the fine structure, and this is almost certainly the reason why electron microscopy of nuclei is not at present a rewarding study.

A.

What are the conditions under which you operate with electron microscopy?

I.M.

You have to have the specimen dry: it has to be in a vacuum, and it has to be extremely thin. Even a bacterium looks totally black when you put it into an electron microscope. You've got to have your specimen thinner than a bacterium. Now the high voltage electron microscopes which are being designed in France and here and in Japan may get over this.

A.

It will blast the material won't it?

I.M.

What destroys your specimen is heat, and the kinetic energy of the electrons produces heating in the stopping material. However, if they are moving so fast that they pass through the material, then they do no damage. They hit individual atoms but that wouldn't immediately alter the structure and you wouldn't burn up the specimen. The normal voltages are 60, 80, 100 KV, but millions of kilovolts are needed for the high energy electron microscope for studying whole cells like bacteria alive and, as you can imagine, the business of designing a 3 million volt electron microscope is no joke, and the whole technology of using such things takes time to develop.

No one has yet convinced me that they have put a live object in and that it remained alive when they took it out. So the present position is that you have got to kill your specimen, and you've got either to spread it out flat (and only certain

things can be spread out flat) or, you've got to cut it into thin slices.

Certain things can be spread out easily: you can *break* your cell, and this is how the DNA has been got out of viruses and bacteria complete: osmotic shock can be used to disrupt a cell so that the DNA can be made to spread out on the surface film of the liquid. You can dry that down, and you've got it out whole. Nobody has yet successfully unravelled a chromosome like that. It is so much bigger – it is bigger than a T.M.V. virus. So much space.

A.

Now what about the partitioning of the cytoplasm? You took my point about having some overall view of organization and countered it by pointing out that there was this remarkable discovery of partitioning of protoplasm, which in fact wasn't foreseen *at all*, so that any overall theoretical model would have been on the wrong foot. Can you tell us about the partitions and what they do?

I.M.

Apart from the "endoplasmic reticulum" which was a wholly new discovery, the first membrane bounded components of cytoplasm to yield to observational analysis even in a preliminary way with an electron microscope were exactly those organelles (mitochondria and Golgi bodies) which is an undergraduate I had believed to be phoney. The mitochondria have got very elaborate membrane systems *inside* (as indeed have other organelles such as chloroplasts which give the green colour to plants) as well as bounding membranes sealing them off from the rest of the cytoplasm. The experimental evidence is conclusive that mitochondria are carrying (internally) the respiratory enzymes which provide energy for the cell. The bounding membranes thus segregate some of the chemical reactions that one could not understand before as being compatible if spread throughout the cytoplasm.

Of course every single reaction in a cell goes stepwise: they are very complicated reactions. Thus in the case of respiration you have the Krebs cycle, but there are a lot of steps, and some of these cycles involve a pattern of molecules on a surface. Such patterned surfaces can in some cases themselves be parts of membranes but they are more often the surfaces of smaller

objects which can be particulate (although still multimolecular). Still smaller objects, the more mobile molecules, are then passed on from one bit of the pattern to the next bit, as on a factory conveyor belt, with one thing being added or taken off at each site.

Ribosomes are a good example of multimolecular particles of this type which themselves may, but need not, be attached to membranes. Ribosomes are composed of ribose-nucleic acid (RNA) instead of desoxyribose-nucleic acid (DNA). They are engaged in protein synthesis which is a totally different thing from respiration. Protein synthesis takes place in the cytoplasm and in the nucleus, but outside the closed spaces where respiration is going on. Mobile particles act as messengers to convey information from the nucleus to the ribosomes in the cytoplasm.

B.

As you know, there is great trouble about any concept of information that messenger RNA brings. What do you think it is?

I.M.

Well, I only know the model that one is told. The evidence is that the information is in the form of the genetic code with its three-bit alphabet.

B.

I know the form of it. The trouble is that it doesn't become information just because it has that form. It becomes information only when one thing is capable of being interpreted as something else : that is what information is.

I.M.

Well now, as far as I've understood it – not being a molecular biologist – the genetic code inside the nucleus remains inside the nucleus, but each bit of the genetic code that is going to function does it as far as I understand by making a replica of itself in RNA instead of DNA and this replica passes out into the cytoplasm as messenger RNA. The bits of the code that are not going to function are presumably sealed off by some mechanism that one doesn't know the details of – the nuclear DNA might perhaps have a layer of something plastered over

it. You don't know what it is that prevents some bits of the DNA from functioning, leaving other bits to do their stuff in any cell.

B.

It is still the case that the replica has got to be interpreted.

I.M.

It is interpreted by the ribosomes which are responsible for protein synthesis. All enzymes are proteins and almost all aspects of cell activity are enzyme controlled. Synthesis of enzymes is thus of critical importance.

B.

You speak of "interpretation" – it doesn't matter *what* interpretation – you have got the idea of interpretation: where did it come from?

A.

And the instruction to interpret. The point can be put sharply by asking how does a given molecule know when to treat another molecule as a message, and when to treat it as just a fellow to be bumped into?

I.M.

The answer to this, as far as I understand it, is structural and comparable to a lock and key mechanism. "Recognition" depends on some critical part of the surface patterning on a messenger RNA particle fitting in a precise manner with an appropriate receiving site on a ribosome. If there is no such site, the messenger will pass by as an inert particle. If there is contact (by whatever means) of the precise kind required to constitute a "locking device" activation of the ribosome follows. That is to say it will receive a stimulus (of whatever kind) as a result of which free atoms or molecules within reach will become attached to a selected conveyor belt, thereby initiating synthesis of a particular product. Selection of one conveyor belt among the millions of alternatives potentially present on a surface as complex as that of a ribosome is determined by the precise lock and key which have operated. These also determine the length of time that the conveyor belt will be used i.e. the size as well as the nature of the product and

the precise point in time at which the messenger will disengage leaving the ribosome free to receive another. It is not necessary and indeed is rarely possible to define the exact details of what is meant by "contact" and "fit", since these will vary from case to case. So also will the transmission medium i.e. the stimulus which passes across the locking device to produce "activation". Such stimuli can be varied and potentially include things as diverse as light flashes, electric pulses, free electrons, moving atoms or ions, sound waves or whatever. Effective receipt of a message requires, lock, key, the transmission medium (stimulus) and presumably also the medium of response (conveyor belt) at least in some cases. The message itself on the other hand seems to me to be the pattern i.e. the structural or other discontinuities, contained in the key and impressed on the transmission medium.

I admit that the use of an emotive word such as "information" (and the still more emotive word "interpretation") for a pattern in such a context came at first as a shock to me as a cytologist because it seemed to imply "understanding" in the human sense by the recipient. On reflection however it became clear that this type of understanding is only a special category of response and is not essential to the concept of information itself.

Does this answer in any way meet your needs?

A.

Yes, it certainly does in one important way: of course I didn't doubt that further investigation would in time reveal some mechanism for the information transfer, and it is nice that this knowledge is to hand already. However, I would be a bit surprised if the current talk of "information", "codes", "messenger" and so on were all just a *façon de parler* which could be done without. If you insisted that this kind of description and the description of the mechanisms were exactly equivalent, then I would have to go back to the point I asked you about right at the beginning, concerning the interlocking of the enormous number of control processes in a living organism, and the resulting impossibility of understanding the overall control. When you take the explanation of effects back to greater and greater molecular detail, as you do in your lock and key mechanism, so you get further and further away from being able to grasp the whole (in the sense of

predicting its behaviour). Notions like "information" have a simplifying effect and allow you to get much nearer to a model that you can handle and use predictively, but it seems to me that they can only do this in virtue of the colloquial meaning being included, for it is that which suggests how we should handle them. We can't do without it, and it is irrelevant from this particular point of view that we know the detailed mechanisms.

I.M.

I suggest nevertheless that it is not irrelevant to remember that you and not I introduced most of these words in the first instance; I should otherwise have been far more cautious in arguing with philosophers without first defining terms. I suspect that we ought now to go back to the beginning and sort out the implications of language more fully; otherwise we may be in danger of discussing quite different things. My own interest in exploring the contents of a previously unfamiliar region of space is perhaps no more relevant to your real problem than, say, analysing the mode of action of a telephone which might incidentally be easier to deal with. At this point therefore I suggest we call it a day.

A.

Yes. I admit that my problem is rather general and would have come up in some form if you had wanted to describe the cell in terms of telephones, but you didn't.

Engineers care for People*

Sir Frederick Warner

The celebration of any centenary is based on the search for justification. We are faced with questions which demand answers:—why are we here; how did we get here: where are we going? We need the comfort which history can give: we repeat old rites for new generations and hope they will feel comfort in the ritual. So we keep our University Chancellors and dress them up once a year to confer degrees on a new batch of graduates. The ceremony remains even if the need of gowns and hoods as recognition symbols has almost gone. We should feel poorer without it, most of all the new graduate. For the colour and ceremony are part of his demonstration in public, before his friends and his parents, that he has become part of an academic society which has a continuous history and that he has been admitted by apostolic succession. The direct bond of university membership is a fact which is not diminished as education becomes available to more people in a broadening society. The hundred years of this university have been only a preparation for the outcome of 101 years of compulsory elementary education.

The community to which we are admitted stands on the right to intellectual freedom of everyone in it. In my own world, that of engineering, this right is bound up with the duty to act, to invent, to build although the result may be to overturn social institutions. What we hold on to is the need to care for people.

It is only possible to make any sense of the assertion that engineers care for people if alternative opinion is examined. This is the thesis that technology, i.e. the work of engineers, has caused a fundamental destruction of the qualities which make life healthy and happy. The inventiveness of engineers has given us products which are not really needed or desired, but are marketed in a way to persuade people that they must have them. The resulting demand then places pressure on resources so that more and more of the earth's material resources are extracted and converted into ephemeral products which

* A Centenary Lecture given in the University of Newcastle on October 15th, 1971.

end up in accumulating piles of rubbish. Where they are not ephemeral, they can be worse – in terms of increasing building of houses, offices and factories and the scarring of the countryside by new roads, quarries and mines.

The first stage of an intellectual critique of such a system is to try and call a halt. The economic troubles of the world, and of this country in particular, would be less if the idea of growth were abandoned and society stabilized with zero growth. The second stage is to turn back, not to a pastoral society, but a simpler form of society where living in communes would reduce demands on resources. Both philosophies are normally put forward by those who have been accustomed to having the good things and taking them for granted. They are, in fact, advocating the preservation of the status quo and make no allowance for even changes in equilibrium.

I would plead for engineers to take a position based on the experience of their own work. It means a return to confidence that obstacles can be overcome, that there will always be obstacles and failures in life which are the challenge to the human spirit. The other way is to be paralysed and to exhibit the “trahison des clercs”. Passivity and inactivity are the treachery of intellectuals particularly when they appear as opposition to change rather than as part of the aspect of man which is contemplative.

The classical engineer who knew all about this was Pascal. Apart from his contributions to mathematics and fluid mechanics, he produced in the *Pensées* an intense poetry which matches his feelings and his reflections. Every schoolboy knows his phrase about the heavens: *Le silence eternal de ces espaces infinies m'effraie*. But right at the beginning of the *Pensées* in Article 1.1 comes the passage which always comes back to me as a fundamental statement.

“Tout change: rien ne s'arrête pour nous. C'est l'état qui nous est naturel, et toutefois le plus contraire à notre inclination: nous brûlons de désir de trouver une assiette ferme et une dernière base constante, pour y édifier une tour qui s'élève jusqu'à l'infini; mais tout notre fondement craque et la terre s'ouvre jusqu'aux abîmes.”

(Everything changes: nothing stays still for us. It is the state most natural to us and at the same time most opposed to our inclinations: we are on fire with the urge to find a firm base and a final unchanging site on which to build a

tower which rises to infinity : but all our foundations split and the earth opens to the abyss.)

This passage states a proposition about change and reminds us to accept change as the most natural part of our existence. It also reminds us that all states of equilibrium are dynamic, that some changes are reversible and some irreversible. I think it is also in opposition to a current analogy of our Earth as a space-ship which needs to have all its parts designed for a closed system and everything regenerated. The Earth is far from being a closed system as long as the sun pushes in an average of 1 kW/m^2 at the equator.

But since the argument about space-ships is most frequently raised in discussions about deterioration of the environment, I would like to take some actual examples of change and adjustments in equilibrium. These may also illustrate the rapidity of some changes and the factors which can change only slowly through system inertia. They will come from my own background of chemical engineering and I acknowledge in advance and criticism that the field of my selection is indeed much wider than most people would allow for my discipline.

Let me start with one example from a part of industry based on Newcastle and take a look at Proctor and Gamble. They have been in the business of synthetic detergents on an increasing scale over the past 20 years. These have brought a profound change in the life of women which most of us can register. They have been emancipated from the old copper, corrugated wash-board and hard bar soap, in this country at least. Even the equivalent of pounding the clothes on rock by some cold stream before drying them in the hot Mediterranean sun has attractions only for those not engaged on the job. The work was so hard that no more than necessary was done and the standards of cleanliness had to be maintained at levels which were just tolerable or aided by systems involving re-use, such as clean collars with the old shirt, sheets put top to bottom etc.

The waste waters produced by these old methods were not very troublesome in sewage treatment works or the rivers to which eventually they were discharged. The materials they contained in the way of insoluble calcium soaps were traditional and the sewage works were adapted to them.

The position became different when technology looked for

ways of improving the washing process, so that it became less laborious but more effective. Also new materials which did not require fats for their manufacture, as soap does, were developed at a time when there were serious food shortages in the world. In terms of efficiency in cleaning soiled cloths, a remarkable advance was made. It was due principally to two components of the new washing powder, the surface active material which removed oily dirt by lowering surface tension and phosphates which kept the scum dispersed so that it did not settle on surfaces, whether of the washing equipment or the cloths. The great improvement in washing results was at once evident. The scum deposited through normal rinsing in hard water began to disappear from the pores of fabrics, leaving them brighter in appearance and softer to handle. The way was also paved for the introduction of washing machines which would not become covered with dirty residues clinging tenaciously to every corner. A technological advance of great social consequence had been made, responsible for more women's liberation than any other single agent until the advent of the Pill. It freed women from domestic drudgery so that they could choose whether to work outside the home and add to the family income. The liberating process has been continued by the marketing of fabrics which need no ironing. Its effects are demonstrated by the choices which have been made of better, gayer, more fashionable clothing among the whole population leading effectively to a more open society in which differences of wealth are not apparent from clothes. Even more, the premature aging has gone, and this is reflected in clothes and style.

This was an environmental change which should be weighed for its benefits when considering the other environmental changes which followed and were, for a time, disadvantageous. It was a change which should have halted any revival among sociologists of Veblen's Economic Theory of the Leisure Classes. The three criteria of conspicuous leisure, conspicuous expenditure and conspicuous waste vanish when the whole population is spending on luxury and waste. When it is universal it ceases to be conspicuous.

Let me return to the environmental disadvantages. These were seen first as the appearance on rivers of thick masses of foam which often built up to considerable heights and were blown across adjacent roads and property. It was also found that

the performance of sewage works was deteriorating and that they no longer produce effluents which were satisfactory for discharging to rivers. The effects were serious, as they came on top of a sewage system which was already overloaded because of the growth of population, the increased use of water and the inability to invest in new installations because of the war and its aftermath.

The problems were identified by a Government committee under Sir Harry Jephcott, an industrial chemist, as the result of persistence of the surface-active materials through the sewage works and in the rivers. The normal processes of biological attack were ineffective with the alkylbenzene sulphates which were used at the time as the essential component to be incorporated in the domestic detergents. As a result, a standing committee was set up in 1957 to find ways of making materials which could be biologically broken down in waste waters and then to find ways of phasing out the old "hard" materials.

Research and development soon produced materials which, in the laboratory, appeared to have the right properties. Their testing in actual working conditions proved more difficult. The town chosen for a full-scale trial was Luton and plans were put into action for the replacement of all domestic washing-powders by special formulations containing the new material. It took much longer than expected to replace what was on the shelves of the local shops and even after that the old "hard" material continued to turn up by routes which could not be traced. When success with the experiment was at last established, the whole detergent industry turned to shutting down the old production units and to change over to the new biodegradable materials.

The reversal of environmental deterioration has been made clear by the disappearance of foam from almost all our rivers. The exceptions I will come back to later. In the sewage works, satisfactory treatment has been restored so that they operate to their old standards of producing effluents which can safely be discharged to rivers. With hindsight, the charge is made that manufacturers should have foreseen the effects which "hard" detergents would cause, and should have held up the marketing of the new washing powders until "soft" materials had been developed. I doubt whether enough was known at the time for this kind of foresight to have been reasonably expected. We are still far from understanding all the factors involved in

the formation of persistent foam. We certainly did not know enough at the time about the effect of surface-active agents on oxygen-transfer processes.

I have deliberately excluded so far any discussion about the phosphate content of detergents. You will have read many articles and seen many television programmes which say that horrifying things are happening in the United States of America and that eutrophication is a menace which demands urgent action to ban the use of phosphates. Phosphates have indeed been banned in many States or limited in the proportions which may be used. As alternatives, the consumer is offered products which are not as effective and can be domestic dangers because they are so caustic. There has also been a great deal of research done on substituting materials for phosphates and the claims of the sodium salt of nitrilotriacetic acid (NTA) have been strongly urged, particularly in this country.

In this field of detergents, it is not enough to have reached a good position. There are always factors which can worsen it. One of these is simply growth, so that more detergents are consumed, more fresh water is used and more sewage is discharged. Unless new sewage works are built, the detergent residues will enter rivers and interfere even with the natural pressures by which they themselves are destroyed. The task of breaking up the residues biologically can be assisted by improving efficiency of the detergents and their susceptibility to alkali. The materials in the domestic detergents manufactured in this country indeed are capable of being destroyed up to 90% and over. It is necessary to be vigilant about materials, made outside the U.K. which may be cheaply imported but are not as good. The European Economic Community has a directive that materials must be capable of 80% destruction. This directive is one of those which new members of the Common Market must accept as part of the removal of non-tariff barriers to trade. Fortunately the major companies have common manufacturing standards which should protect the improvements made here without public health considerations arising. It would be ironical if a satisfactory situation obtained by voluntary agreement were to be destroyed by adopting a uniform protective regulation. I will return later to the particular problems which exist in this country and the way in which so far engineers have been able to look after us.

Before leaving this question of detergents, I would refer

briefly to the problem of industrial detergents which are used for heavy duties, particularly in textile industries. Some persistent anionic and a great deal of non-ionic detergents are still used and give problems such as those on Yorkshire rivers. I believe we are in sight of further voluntary agreement which will result in these substances being replaced by satisfactory substitutes by 1973.

I hope that this example has given some details of the interaction of technological advance and social needs. It may also have shown the different levels of needs, progressing from the removal of grinding poverty and toil to the concern for all God's creatures, who make up a glorious and infinitely various world which is at risk if exploited. The basic ethical problem for engineers is to serve man by making available for his use and convenience the gifts of nature without abusing them.

His problem is one of accountability and then of accounting. I distinguish between the two because engineering is primarily an art in which judgments are made on grounds which may not always be quantitatively exact. Accounting comes later when measurements can be made after the event, and more and more these are showing that the changes in our lives and concepts are producing complexities which require more rigorous checks and controls.

Engineering processes are today so complex that the sums to be done can be encompassed only in the computer. The sums themselves are only ordered however, by the imperfect model we construct in order to programme. The print-out should therefore reinforce and not restrict accountability but must come back to the engineer who has chosen the model. He remains an individual who cannot be left with lonely decisions. He may and indeed must, in the end take a decision on his own authority but he needs advice and criticism before he takes it and support after it. The best organizations work in this way and the worst substitute the views of committees and allow the structure to confuse responsibility.

This may seem to give a picture of the engineer which confirms the criticism that the evils of technology stem from the acceptance of a hierarchical system. The criticism of course completely confuses responsibility with hierarchy as if they were inseparable. Inside the most rapidly developing society, where change is accepted as normal, hierarchy is needed for

essential services which must take prompt action without discussion. Such services whether for fire-fighting, peace-keeping or running an airline have to have a stable recognized system in all parts of which the duties are defined and prepared for by training. By contrast industry has limited stability, little chance of prolonged periods of uninterrupted production and an anxiety about the future which results in continuous questioning. The organization which develops as a result has much more of the character of a honeycomb than a pyramid. Each cell tries to appraise its own function and checks its objectives against this of its neighbours and the organization as a whole. The criticism often made of engineers is that they become blind to things which go on outside their own cells, fail to define their objectives in terms of the needs of the whole organization and fail to consult with others. I think these failures are not peculiar to engineers but they occur and, when they do, place at risk the future of whole enterprises and their working force and weaken the country as a whole.

In my view, there will develop inside engineering the will to have the most precious designs and concepts audited. I use a term from accountancy since it seems natural that progress should be made from accountability to accountancy. Every engineer who is creative wants to feel free to drive ahead and overcome obstacles and he should be encouraged. For his own protection and that of the public, some kind of technical auditing seems inevitable.

I see the elements of auditing already in existence but not yet consciously incorporated as a function of industrial life in the way that accounts are. It seems to me possible that our next stage of control of environmental deterioration may well need to incorporate some form of auditing. The elements are already in existence in the shape of the control exerted by officials under their statutory powers over air and water pollution. But this seems to me without the advantage which auditing of company accounts gives. It is equivalent to having operations which give rise to the contamination of air and water under perpetual threat of legal sanctions. This is too extreme a position and the finances of a company are protected in a better way. The auditors of its accounts are appointed, not by the directors, but by the shareholders in general meeting. The auditors are in the first place responsible for certifying to the shareholder that the accounts have been properly

prepared and they have the right to qualify their certificate if they do not agree with the methods used and explanations given. This duty to the shareholders is also a duty to the public on whose behalf enquiries may then be made to see if any breaches of the Companies Acts have occurred.

I see the need for the process of technical accounting to become incorporated in company procedures just as financial accounting. The objections can be foreseen – that competent people are confined to those inside a company with a detailed knowledge of what goes on – that the company is already satisfied with its procedures – that it could certainly not find independent auditors adequately qualified even if it were prepared to open its books – that the operating results demonstrate that everything possible has been done.

Similar arguments could have been raised to the auditing and publishing of company accounts. It can also be stated that auditing does very little to improve the operation of companies and does not give adequate warning even when they are in great difficulties. If this is an argument at all, it is one for reform of accounting. I think the public is entitled to know how far the policy of companies is directed towards obtaining a statement of ends and achievements in an environmental protection which can be regularly and routinely reported on to management. There is need to know that the fine detail of operations is continuously scrutinized in order to reduce the escape of polluting material, to re-use whatever can be re-used and to set targets for improvement. It is difficult to see how this work can be carried on indefinitely by internal agencies only.

Of course some forms of external control already exist. The powers of the Alkali Inspectors, of local authorities under the Public Health Act and Clean Air Acts, constitute a partial control but it is not complete in the sense that accounting is. Nor is the control by local or river authorities on effluents discharged to sewers or streams. The transition has not been made from definitions in terms of quality to those in terms of quantity. It is the area where the chemical engineer's approach corresponds more nearly to accounting, since his discipline is based on describing systems in terms of the fate of all energy and all materials. His material balance sheets in fact often show two arrows at the end, one pointing up to the chimney and the other down to the drain. There is no reason why each

arrow should not bear its box containing the quantities of materials going to each sink, whether waste gases or waste waters with all their contaminants. It means that more attention will be needed during design to monitor the quantity and quality of various streams so that the masses involved can be assessed.

The transition from qualitative to quantitative statements will allow industrial undertakings to build up their own detailed accounts of what goes on internally. The existence of this information will itself generate the pressure to reduce unnecessary pollution, to have some historical criteria by which progress can be judged and make a contribution to the overall consolidated accounts which will be reasonable. In face of all the speculation about pollution and the need to have positive programmes to ensure continuous improvement, the accumulation of actual data is a positive step. It could be undertaken at comparatively little extra cost in many factories, by better attention to the systematic use of records. The adoption of a system in itself soon leads on from the initial analysis of data to identification of other information necessary to complete the picture.

It is the hope of all those concerned with problems of air and water pollution in particular areas to construct models which can be used for prediction. An outstandingly successful model, that of Pollution on the Thames Estuary, was constructed by the combination of a physical model of the main characteristics of the estuary together with a theoretical approach to the chemical and physical mechanisms responsible for overcoming pollution. The assumptions made were checked and necessary corrections made in the model by using the data, on such leading factors as oxygen concentration, which have been collected since 1893. It happens that the Thames Estuary was suitable for constructing a mathematical model because of certain peculiarities. The existence of a weir at Teddington represents a hydraulic discontinuity and gives a finite boundary to tidal influences and salt incursion. It is also full of twists and bends so that each section of the river becomes thoroughly mixed and there is no stratification in which dense salt water flows under a layer of light fresh water. These characteristics which simplify model making are not present, for example, in the River Tyne. We make progress, however, by finding ways to solve problems of increasing complexity. The solving of

the 36 simultaneous differential equations required to deal with chemical reactions in the River Thames was only possible when computing facilities became readily available. The computer also makes it possible to run through accumulations of historical data in order to improve models or to permit at worst the construction of a model to give a best fit of data by regression analysis.

Over and above all the tricks which mathematics allow us to play is the confidence given by masses of figures. Engineering solutions can be put forward to improve conditions, even where the understanding of underlying physical and chemical mechanisms is limited. The Thames Estuary has shown this over the last century, particularly in the imagination exercised after the cholera epidemic just over 100 years ago. The work undertaken to intercept all the drains and polluted streams flowing directly downhill into the Thames along its length has left us the legacy of the Northern and Southern Outfall Sewers which end at Barking and Crossness. They have borne the burden of transporting the vastly increased quantities of waste, which have come with increased numbers and water consumption, to points away from the centre of population. Even so, the river became so polluted that salmon ceased to run up the river after 1890. It is a tribute to the additional works of sewage purification undertaken steadily since then and in particular since the publication 10 years ago of a report by the late Prof. Pippard. His report made recommendations to allow work to be put in hand in advance of all the computational work connected with the mathematical model. It was a case of taking prompt action when enough data had been accumulated in advance of complete theoretical treatment.

The improvement since then has been spectacular, the most notable indicator being the re-appearance in the Thames Estuary of 54 different kinds of fish including brown trout and, in this spring, two sea-trout. This is the first recorded instance in the 20th century of this migratory fish. The records are being built up by Mr. Wheeler of the Natural History Museum by collecting specimens trapped on the filters which are used by Thames-side power stations on their cooling-water intakes. The returning life could be quickly driven away if there were any complacency about the improvement. The inexorable growth of population and water demand around the Thames Estuary requires increasing purification of the waste waters

discharged so that the demand for oxygen by the rubbish can be not only halted but reduced. For long periods of the year, the oxygen which can be supplied by fresh-water flow is extremely limited and almost all of it has to come in from the sea on the tide. A part only can be taken in direct from the air. Ever since 11 September, 1971, the fresh water flow from the Upper Thames over Teddington Weir has been $13 \text{ m}^3/\text{s}$ or 250 m.g.p.d. This has to chase out of the estuary over twice its amount of sewage having had varying degrees of treatment, arising from the activities of nearly 10 million people around the banks. There is no other situation in the world to compare with it and the engineers have served London well in controlling and improving the river. If you wish to compare the prodigality in dealing with resources elsewhere, look at the port of Rotterdam which has under 1 million people around it and needs to control the flow of water through it at $6000 \text{ m}^3/\text{s}$ or nearly 500 times as much as the Thames in summer, discharging its surplus through the huge gates of the Deltë Barrage. Let anyone comparing the waste discharged into the N. sea from bordering countries just bear in mind what these figures mean.

I have gone on about two particular fields which touch me personally as they do countless other engineers and technologists. We still need to have the social support as well as pressure and criticism to allow adequate investment to be made for meeting priority needs in the environment and to keep the earth with all its beauty of creation.

Prototypic Organisms VI: *E. coli*

Mary Osborn

Jacques Monod has said "What is true for *E. coli* is true of the elephant". That most molecular biologists have chosen, in the last two decades to work with *E. coli* rather than the elephant reflects two things. Firstly, that they believe that the rules which govern some of the most basic of life's processes, such as cell growth and division, would be the same in bacteria and higher cells, and secondly that *E. coli* is much easier to study in the laboratory than the elephant.

Bacteria are obvious choices for study. They grow in their natural environment as single cells, and in the laboratory they can be grown again as single cells in simple media which have a defined chemical composition. The time which it takes a bacterium to divide into two daughter cells depends on the type of medium on which the cells are grown: in general the richer the medium the faster the bacteria will grow. They can also be grown in large amounts so that chemical studies can be carried out, and so particular molecules can be isolated. Often hundreds of grams of cells are used, and some idea of the volume this involves can be gathered if it is realised that a cup of bacteria might contain 3×10^{11} bacteria and that these would weigh approximately one tenth of a gram. There is the further advantage that genetic analysis can be performed with many bacteria, and mutants defective in particular biochemical reactions can be isolated. That *E. coli* rather than some other bacterium occupies such a dominant place in molecular biology is largely a matter of historical accident – once scientists started working with it, and information about it accumulated, its use snowballed, so that if *E. coli* could be used for a particular experiment it was used.

The original source of the strains of *E. coli* used in the laboratory was from sewage. *E. coli* or "the colon bacillus" is one of the predominant species present in the large bowel, and its presence in water supplies is often used as a test of fecal contamination. It is non-pathogenic for man, and is handled in the laboratory without special precautions. Some strains can however cause diseases of the urinary tract in man, and gastroenteritis in infants. Most strains are susceptible to the sulfonamids, strepto-

mycin, chloramphenicol and the tetracyclines.

Growth

E.coli is cylindrical in shape, and approximately twice as long as it is wide. Five thousand placed end to end would give a length of one centimeter, so individual cells cannot be seen with the unaided eye. Under a light microscope they appear as black bodies, and by looking at large numbers of cells it can be deduced that the cells grow by getting longer (the diameter is constant) and that when they reach a certain length they divide to give two cells of equal length. Thus each molecule of the parent cell ends up in one of the two daughter cells. To determine whether the bacteria are alive or dead it is usual to test them for their ability to form colonies on solid medium. This is done by spreading a small number – say one hundred – bacteria on a medium containing the necessary ingredients solidified by agar. Those bacteria that are alive divide to form daughter cells, which in turn go on dividing, so that in a day or so each of the original bacteria that is alive has given rise to a colony of cells which contain so many bacteria that they are visible to the naked eye. The colonies are white and convex in shape, and the number of the original bacteria alive is found merely by counting the colonies.

One can also determine whether cells are alive or dead by using liquid medium. If a tube containing growth medium is inoculated with a few *E.coli*, placed in a water bath held at 37C, and air bubbled through it, after some time the contents of the tube will appear turbid, and the turbidity which is a direct reflection of the number of bacteria in the tube will increase with time. With experience it is possible to tell the number of bacteria present merely by looking at the tube.

The cells can stop growing, or change their growth rate for a variety of reasons. Some examples are too high a temperature (above 44C) too low a temperature (below 15C) exhaustion from the medium of an essential nutrient, poor aeration or infection with a virus. The cells grow fastest at 37C. In a medium containing glucose as energy source the bacteria will double in number every sixty minutes. If, in addition to glucose, precursors to nucleic acids and precursors to proteins are added to the medium the division time may be as short as twenty minutes. Eventually however when the number of cells reaches more than 2×10^9 per ml they stop growing, and the cells will only

start growing again if they are diluted into fresh medium.

Structure and chemical composition

Some details of the structure of *E.coli* can be deduced from pictures taken of very thin cross sectional slices of *E.coli* taken with the electron microscope (see Figure 1). On the outside is the cell wall which is rigid and determines the shape of the cell. It protects against mechanical damage and allows the bacterium to tolerate a wide variety of environmental conditions. From it project various kinds of appendages called pili. Inside the cell wall is the cell membrane which determines the types of molecules that can enter and leave the bacterial cell. Like most other membranes it is made of two types of macromolecules – lipids and proteins. In *E.coli* there is little visible internal structure, and in particular no nucleus and no nuclear membrane.

If one looks at the chemical composition of an *E.coli* cell, 1% is deoxyribonucleic acid (DNA), 6% is ribonucleic acid (RNA), 15% is protein, and of the remaining 78%, 75% is water. Each of these macromolecules is a linear structure built up of a variable sequence of a small number of more basic units. In *E.coli* each DNA molecule is a string of approximately 3×10^6 bases, but there are only four different bases: adenine (A) guanine (G) cytosine (C) and thymidine (T). RNA, depending on the particular type, can contain anything from 60 to 4000 bases but again there are only four different bases, A, G, C and uracil (U). Proteins usually contain 100–500 amino acids, and there are twenty different amino acids.

DNA is the genetic material

Twenty-five years ago it was not known for certain which of the macromolecules contained the heritable information. That it is indeed the DNA molecule was shown by Hershey and Chase in an elegant experiment using *E.coli* and a DNA containing virus which can infect *E.coli*. The virus contains one DNA molecule covered by a coat of protein molecules. Both the DNA and the protein can be “tagged” with substances called radioactive tracers so that the fate of both the DNA and protein molecules of the virus particle can be followed after allowing the virus to come in contact with an *E.coli* cell. It was shown that the viral DNA molecule enters the *E.coli* cell whereas the protein molecule remains outside. Since the virus replicates inside the cell, the genetic information necessary for this replication and for the

subsequent production of many hundreds of progeny phage must enter the cell. Therefore DNA is the genetic material.

Once Watson and Crick postulated their structure for DNA it became apparent that the information contained in DNA is contained in the sequence of the four nucleotides along the DNA. In *E.coli* the DNA is double stranded, and like all double stranded DNA the two strands are thought to be complementary in sequence. This means that if an A is present in one strand a T will be opposite it; alternatively if a G is present in one strand a C will be opposite it. The DNA in *E.coli* is present as 1–4 identical copies per cell. The exact number of copies present depends on the growth conditions and on the state of cell division. Each copy if extended would be about one tenth of a centimeter in length – this is five hundred times the length of an *E.coli* cell, so that the problems of packaging the DNA are obviously formidable. It has been shown that the physical form of each double stranded DNA molecule is circular. When DNA replicates the strands separate and each strand is used to form a new strand of complementary sequence. At cell division opposite strands of the parental DNA molecules go to different daughter cells. The exact details of how the cell accomplishes this remain to be worked out.

DNA —→ *RNA* —→ *protein*

E.coli has also contributed to our understanding of exactly how DNA is transcribed into RNA and how the RNA is translated into protein. This process is indicated diagrammatically in Figure 1. The information in one of the strands of DNA is copied into a particular type of RNA, messenger RNA, by a protein molecule called RNA polymerase. Ribosomes, which are small spherical particles which contain RNA and protein, (there are approximately 30,000 ribosomes in each *E.coli* cell), then attach to the messenger RNA, and using intermediate molecules called transfer RNA the messenger RNA is translated into protein. Recently it has been possible to visualize this process, and to observe the DNA, RNA and ribosomes stopped at particular points during transcription and translation. This is done by special techniques in which the contents of an *E.coli* cell are spread out on a grid before examination with the electron microscope.

One may ask what the rules are for transcription and translation at the molecular level and what the relationship is between

the sequence of bases in the DNA and the amino acids in the protein. This relationship is called the genetic code. For example, a triplet TTT in one strand of the DNA will be transcribed by RNA polymerase into the triplet AAA in the messenger RNA. When the triplet AAA is translated, one particular amino acid, lysine, will be incorporated into the protein being made on the ribosomes. The genetic code was worked out largely by joining the four bases A, G, C and U in particular defined sequences, and then seeing which amino acids were incorporated into proteins when these strings of bases were added to an *E.coli* extract. Subsequently many of these results have been verified by determining the base sequence of a particular part of a viral RNA molecule which codes for a protein of known amino acid sequence. There are 64 possible triplets since there are four different bases in RNA but there are only twenty amino acids. Thus more than one triplet codes for a particular amino acid. There are three triplets that signify no amino acid, and are believed to be stop triplets, that is the protein chain stops when it reaches one of them. It is possible to transcribe and translate some DNA and RNA molecules directly in the test tube, though with not as high an efficiency as in *vivo*.

Mutant Bacteria.

Each part of the DNA coding for a protein molecule is called a gene. One can construct a map of the position of different genes in the *E.coli* DNA molecule by using various genetic tricks. Usually one starts with a mutant *E.coli* which is unable to perform the particular function one wishes to map. Examples of the type of mutant which can be isolated in *E.coli* are mutants which require particular amino acids for growth (the normal *E.coli* does not require amino acids for growth), mutants which are resistant to various viruses to which the normal *E.coli* is sensitive, and mutants which are resistant to various drugs to which the wild type is sensitive. Isolation of some types of mutants can be very easy – for example for drug resistant mutants one spreads 10^8 bacteria on a solid agar surface containing nutrients and the drug. The drug will kill all *E.coli* that are sensitive to it, and only *E.coli* that are resistant will give rise to colonies. *E.coli* possesses very great advantages for such studies. Firstly it has a short generation time so one does not have to wait too long to examine progeny. Secondly a large number of cells can be handled easily. This is important because a particular mutant

may occur only with a frequency of 1 in 10^6 . The map that can be constructed for these various mutants shows that the genes can be precisely located on the DNA molecule, and that genes that code for proteins with a related function are often physically adjacent. One way in which the synthesis of particular proteins is controlled in *E.coli* is illustrated in the next section.

The lac operon.

In 1961 Jacob and Monod proposed a model for the way in which the synthesis of three particular proteins was regulated. Their model for the lac operon is illustrated in Figure 2. Lactose is a particular sugar which can be used by *E.coli* as its energy source. Metabolism of lactose requires two particular proteins: a bacterial permease which is found in the membrane, and β -galactosidase which cleaves lactose into smaller molecules so the cell can use it. If *E.coli* is grown on an energy source other than lactose then both the permease and β -galactosidase are found in very low amounts, of the order of ten molecules per cell. If, however lactose is used as the energy source the rate of synthesis of the permease and the β -galactosidase is increased by a factor of a thousand, and is the rate of synthesis of a third protein, transacetylase whose function is unknown.

The genes for β -galactosidase, permease and transacetylase are physically adjacent on the *E.coli* chromosome, and are indicated in the figure by z, y and a respectively. The transcription of these genes starts at a particular point on the DNA called the promoter, and the whole lac operon is transcribed into a single piece of messenger RNA. If lactose is not present then a particular protein, the lac repressor, made by the i gene, stops the transcription of the genes z, y and a. It does this by binding to a specific sequence in the lac operon, known as the operator, which is between the promoter and the structural genes. If lactose is present then lactose will bind to the repressor, pulling the repressor off the DNA of the operator, and allowing transcription of the operon.

Since this model of negative control was suggested almost all its predictions have been verified. Mutants both in the structural genes and in the controlling genes have been isolated and have the expected properties. The repressor has also been isolated and characterized. Currently both the amino acid sequence of the repressor and the base sequence of the operator are being

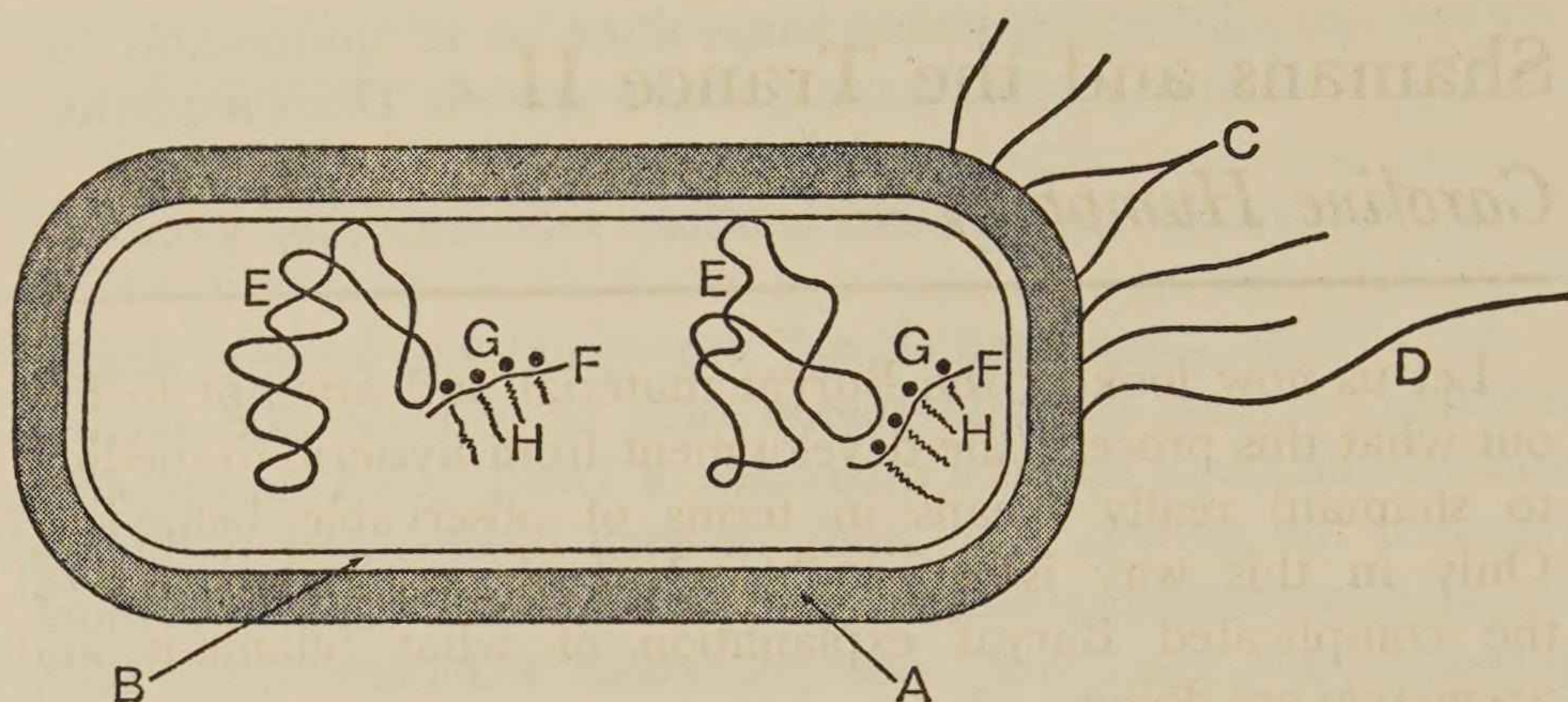
worked out. These sequences may allow us to understand for the first time how a protein recognises a specific DNA sequence.

Over one quarter of all biochemical reactions that occur in E.coli are known.

As already mentioned *E.coli* can grow on a very simple medium. It can degrade sugars such as glucose and lactose and rebuild them into the molecules of DNA, RNA and protein required for growth. The study of such biochemical pathways is called intermediary metabolism, and in many cases individual proteins that can carry out particular reactions have been isolated. As a result of such studies the pathways by which macromolecular synthesis in *E.coli* occurs are known, at least in outline, and one can estimate that some eight hundred reactions that occur during these processes could be documented. It can be asked whether there is an upper limit on the number of metabolic reactions in *E.coli*. In fact there is because of the following argument. As we have seen each set of three bases in an *E.coli* DNA molecule determines one amino acid. Thus an average sized protein containing 300 amino acids requires 900 nucleotides to specify it. The total number of bases in an *E.coli* DNA molecule is 3×10^6 , and this is therefore sufficient DNA to code for $(3 \times 10^6)/900$, or about 3000 proteins. Hence since we know 800 reactions that do occur, we may suppose that at least one quarter of all metabolic reactions that occur in *E.coli* are known.

It has been possible to outline only a few of the contributions that have been made using *E.coli* in the past few years. It is still a useful and powerful system for the study of selected problems in molecular biology and there are many people still using it as a prototypic organism. In addition much of what we know about *E.coli* has proven true for higher cells. For example the genetic code appears universal and the mechanisms for protein synthesis are very similar. Thus many scientists who once worked with *E.coli* are now studying higher cells in the hope that the knowledge we have garnered about *E.coli* may be useful in studying the much more complex cells of higher organisms.

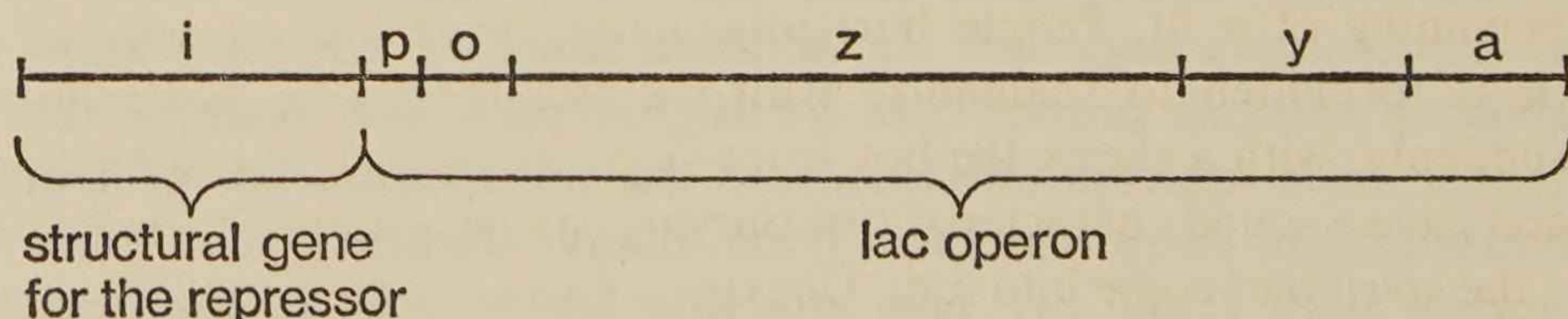
FURTHER READING: J. D. Watson, "Molecular Biology of the Gene", published by Benjamin.



Legend to Figure 1

Schematic diagram of an *E. coli* cell.

A: Cell wall which gives protection against mechanical damage. B: Cell membrane which controls which molecules may pass in and out of the cell. C: pili, or hair-like appendages, of which there may be several hundred per cell. D: F-pili, a special kind of appendage to which some kinds of virus attach, present only on so-called male cells, and usually there are only 3-6 per cell. E: DNA molecule. Two are shown within this cell. F: messenger RNA molecule. G: ribosome. H: protein chains being made on the ribosome. A-D can be seen with the electron microscope. The DNA, messenger RNA, ribosomes and proteins are shown schematically, in the interior of the cell. Individual molecules cannot be seen in the intact cell, but they can be visualized if the cell wall and membrane is broken and the cell contents are spread out on a grid.



Legend to Figure 2

The lac operon. z, y and a are the structural genes for B-galactosidase, lactose permease, and thiogalactoside transacetylase respectively. p and o are the parts of the DNA corresponding to the promoter and operator respectively. i is the structural gene for the repressor. For explanation of these terms see text.

Shamans and the Trance II

Caroline Humphrey

Let us now look at the Buryat material and attempt to find out what this process (the development from hysteric to medium to shaman) really means in terms of observable behaviour. Only in this way is it possible, I think, to make sense of the complicated Buryat explanation of what Shamans and *üzemerchi* are doing.

Petri gives the following case of a young man who became a shaman: "I had often stayed with an old, prosperous Buryat of the Ashekhobats lineage of the Kudinsk Buryats, a man who had a single son, aged 18. No-one could help loving the handsome, well-built, agile and strong youth, and I, wishing to be pleasant to the old man, praised his son. But the father shook his head and said: 'Who knows what may happen? In our lineage we have an *utkha* (a line of ancestor spirits). My grandfather was a shaman, my father was a shaman, the *utkha* missed me, but who knows, will it miss Bardakhan too?'

A year later I heard that young Bardakhan had started to have hysterical fits. I hurried to the well-known settlement. In the familiar yurt everything was as it had always been, the things were arranged as before; but a sad ceremonial atmosphere pervaded the place – I felt it in the quiet conversations, the slow movements, and the expressions on the faces. It was difficult to recognize the young Bardakhan. Pale, very pinched-looking, with a nervous face and frightened unseeing eyes, he sat not far from me. 'He has been having these fits for three days now,' explained his father. Suddenly, during the conversation, the boy jumped up; he started to shake; it was the beginning of a fit. People hurriedly undid the belt of his gown,³⁶ (it is forbidden to shamanize with the belt done up). Somehow, suddenly, with a shriek the boy leapt in the air, then leaned forward and gave a sound characteristic of Buryat shamans, – *abrrr . . . rr . . . r* – the spirit had come into him. Unexpectedly, he jumped into the air, leaping up to a height of 2 *arshins*,³⁷ and then fell on his back flat onto the floor.

³⁶ A Buryat gown has buttons at the neck, but otherwise it is held in place by a long silk belt wound round the waist. Women do not wear belts and are known as *büsgüi* "(people) without belts;" the belt symbolises the social position of a man.

³⁷ Two *arshins* is about 4 foot 8 inches.

People near him raised him by his head and stood him on his feet. He continued to tremble for some time. Then indistinctly formed words flew out of his mouth, as though hurrying and losing their way. Accompanied by his own disconnected singing, the boy danced for about half an hour in the yurt. Foam appeared in the corners of his mouth. At last he gave the same sound, – abrrr . . . rr . . . r – and the spirit went away. The young man sat at the respected post, wiping away the sweat pouring from his face with the hem of his gown. He tied up his belt again. ‘Ten times a day it’s like that,’ explained his father.”³⁸

Further material shows that the young Buryats who are later to become shamans exhibit all the behaviour characteristic of the hysteric: in addition to the loss of consciousness, the falling on the ground, and the disconnected speaking and singing described by Petri, they also grow their hair long so that it can cover the face,³⁹ keep their eyes closed, run off into the forest, climb trees, and make sure that they are not alone when the fit occurs.⁴⁰

But there are some items of behaviour which are not described for hysterics but which future shamans seem to use as a demonstration of the genuineness of the possession: the sound “abrrr . . . rr . . . r” mentioned by Petri, also foaming at the mouth, bleeding from mouth and nose, and complete rigidity of the body during the unconscious seizure immediately after the spirit has entered – it is a part of every shamanist trance that the shaman must be lifted to his feet by his head. These impressive and frightening things are necessary to the shaman’s role, but not to that of the hysteric or medium. Petri’s account makes it clear that the possibility of reproducing this specifically shamanist behaviour is suggested to the subject in early childhood, when relatives first indicate to him that they expect he may become a shaman. The doctrine of the hereditary *utkha*⁴¹ means not only that certain representations (of ancestral

³⁸ B. E. Petri. *Shkola shamanov u severnykh buryat* (The shamans’ school among the Northern Buryat), Irkutsk, 1923, pp. 9–11, slightly shortened.

³⁹ G. N. Potanin, op. cit., p. 56.

⁴⁰ M. N. Khangalov, *Sobraniye Sochinenii* (Collected Works), *Nyeskol’ko slov o shamane* (A few words about the shaman), vol. 2, Ulan-Ude, 1960, pp. 144–147.

⁴¹ *Utkha* (or *udkha*) means (1) essence, meaning, content; (2) origin, genealogy. In the present context it is a line of shaman ancestors who have become spirits. Each new shaman of the line (which is transmitted through males and females) can use the power of all the previous spirits, – he can use the reincarnations of these spirits to overcome difficulties (i.e. he can become a fish in order to cross the sea) and he can ask them to help him in defeating foreign spirits.

shamans' spirits) are known in certain families and handed down, but also that a young person from one of these families is not free to behave like other adolescents subject to hysteria, since both he and everyone else would interpret any spirit possession in terms of the *utkha*. This is an important difference between the person who is simply hysterical and the person who is destined to become a shaman: the former is possessed by a spirit, – any spirit, or several different spirits, – whose symptoms arise directly from the internal psychological or physical problems of the subject; the latter must always first be possessed by a specific ancestor spirit, in other words, here there is already an element of professionalism.

According to the Buryat, the beginner shaman has not yet learnt to “master the spirit” (*ongon uralkha*⁴²), – that is, he has not yet learnt to invite a spirit down (*ongon tatakha*⁴³), nor to “inspirit” an object (*ongolkho*), nor to gain a spirit's favour by feeding it (*ongon ideliüülkhe*), nor to send away and neutralize a spirit (*ongon kharyuulkha*⁴⁴). Each of these actions (and they do not by any means exhaust the shaman's repertoire) requires a precise ritual or verbal formulation which is different for each spirit. The shaman must know by heart an enormous body of “language of the spirits,” symbolic language which may not itself have an immediately accessible meaning, but which must have a definitive psychological affect on the shaman's audience. One of the first conditions of such effectiveness is that the shaman's speech should be accepted by everyone as correct and genuine.

This knowledge is acquired by the young shaman in the “other reality” – that is, in dreams and trances. The Buryat say that the shaman's soul is taken every night to a school where it is taught by the spirits of its *utkha*. Each *utkha* has its own school. Thus the Vyerkholsk Buryats have a school on Mount Mondyrka in the Tunkinsk Mountains and the head master is Khyngyr Zarin, the eldest son of Esege-Malan Tengri. But Khyngyr Zarin lives somewhere else and does not come to the school very often. The three main teachers are Mongotoi-Zarin, Khömükhei-Zarin, and Bogdo-Zarin.⁴⁵ Although each *utkha* has a separate school, informants from various regions of Buryatia gave surprisingly similar accounts

⁴² Literally, “to master the representation of the spirit.” *Uralkha* also means “to speak beautifully.”

⁴³ Literally, “to draw (or drag) the representation of the spirit.”

⁴⁴ Literally, “to send the representation of the spirit back.”

⁴⁵ B. E. Petri, *Shkola Shamanov . . .*, pp. 17–18.

of the schools they had seen in their dreams. The young shaman dreams that he is approaching a large settlement of Buryat yurts of the traditional seven-sided type, situated in the mountains. The ancestors, with grey hair and beards, holding the shamanist instruments (horse-sticks, bells, drums, etc.) are in the village, but the young shaman cannot reach them because there is a deep, fast-flowing river between. The shaman can only cross the river by means of a *zele* (horse-hair rope) which the ancestors gave to him. Once in the village, the pupils learn the secrets of the spirits from their ancestors.

In fact, during the period of learning, which lasts until the first consecration of the shaman,⁴⁶ the pupil (called *duulashin* "singer" or *minasha*) travels round the countryside attending as many shamanist ceremonies as possible, asking questions of old people and established shamans, and experimenting with the techniques himself. Usually, an older shaman of his *utkha* (called *esege* "father") is appointed to teach him secret powers: each line of shamans has animal-representations, and the young shaman learns, if for example he comes from the Tarasinsk line, to turn himself into a wolf, eagle, goose, or camel, while if he comes from the Ongo-Khordut line he learns to become a bear and a snake. Sometimes the secrets are more sinister: shamanesses of the Ongo-Khordut line learn to cut open their stomachs, take out a three-month old child, bury it in the hearth, put the after-birth over the door, cut off their own heads and search the hair for lice.⁴⁷ The only ethnographer known to have learnt much of these secrets, Khangalov, concludes that they consist of the manipulation of the organs of the body, particularly the organs of sensory perception, hearing, vision, etc.⁴⁸

Since the information obtained by the future shaman pertains to the other reality, the world of spirits, it is natural that the Buryat should claim that it may only be learnt during sleep or in a trance. In fact, it is quite reasonable to assume that the shaman does use his period of sleep for internalizing and organizing the great amounts of material he encounters at séances and ceremonies during the daytime. Recent experimental work on sleep has shown that it is one function of a certain kind of sleep (paradoxical sleep) to promote

⁴⁶ Among the Buryats shamans are consecrated every twelve years, when each individual reaches the ages of 25, 37, 49, 61, 73, etc.

⁴⁷ M. N. Khangalov. *Tainstvennyye sily shamanov i shamanok* ("Secret powers of shamans and shamanesses"), *Sobranie Sochinenii*, 2, pp. 179–81.

⁴⁸ M. N. Khangalov, op. cit., p. 181.

the synthesis of brain protein necessary in learning, i.e. there is a connection between dreaming and the memorising of large amounts of information.⁴⁹

For it should be clear that this is what the young shaman has to do. While for ordinary people, who have psychological and psychosomatic disturbances, the "spirits" are akin to what we call the unconscious, it seems likely that the entire repertoire of "spirits" must be available to the shaman at a more or less conscious level; – the shaman must be able to perceive symptoms in a patient, and, taking into account the patient's past history, social position etc. allocate these symptoms to a spirit. By "more or less conscious" I mean that the shaman must have a conscious knowledge of the signifiers of the "language of the spirits" although what is signified may not be clear to him. In perhaps the majority of cases the shaman may in fact find out what the "spirit" represents, because there is nothing to stop him, – in other words, his own life experience does not lead him to repress such knowledge; in the other cases, where the spirits do represent unconscious, repressed wishes of the shaman himself, it is still possible for the shaman to operate while retaining the knowledge *and* the neurotic disturbance of his life. Although there is evidence that, in European terms, shamans are often neurotic individuals, it may be that the function of the shaman-tutor (*esege*), is to bring much of the unconscious material ("spirits") to the consciousness of the shaman, – in other words, to increase his self-knowledge, and ideally, his self-control.⁵⁰

The most important result of the shaman's conscious knowledge of spirits is that he can make (or teach other people to make) representations of spirits in the form of drawings or collections of objects. These representations (called in Buryat, *ongon*, pl. *onguud*), are part of the language of spirits – they are made up of signs which are strictly equivalent to the other signs of spirits which we have already noted: symptoms, dreams, hysterical speeches, etc. It is one of the

⁴⁹ Drugs which prevent synthesis of brain protein can prevent the formation of permanent memories, – hence it is believed that learning requires some re-structuring of brain substance. Paradoxical sleep greatly increases during massive learning programmes and is associated with brain protein synthesis. (Paradoxical sleep = "rapid eye movement" or "dreaming" sleep). Ian Oswald, "Sleep, the great restorer," *New Scientist*, 23 April, 1970, pp. 170–172.

⁵⁰ An analogous procedure, also using dreams and the guidance of elders in advancing self-knowledge, seems to take place among the Senoi of Malaya (a culture which, incidentally, also places much emphasis on spirit-possession). Kilton Stewart, *Creative Psychology and the Dream-Watchers*, The Stewart Foundation, New York, 1955.

shaman's essential powers that he is able to draw a spirit out of a human being, where its manifestation is usually harmful, and place it in an *ongon*, where it is harmless, but before this can happen, the shaman must know how to represent the spirit in signs in order to make the *ongon*.

It is also necessary, in the Buryat view, that the shaman should "know himself." This is a concrete process which takes place during a long period of unconsciousness at the end of the training. While it is happening, kinsmen arrive and surround the young man as he lies, half-dead, in his yurt. They sing, "Our shaman will come alive again! Our shaman will save us!"

The West-Buryat shaman Bulagat Bukhasheyev has described what happens: "When they have finished teaching the shaman, the spirits of the *utkha* cook his meat until it is done, so that he should know the shamanist grammar." He added, explaining the above statement, which he had made in Russian: "*Mikhang otlood togondo shanat boloso mikha, byiere tanzhaba* – 'My meat was chopped up and boiled in a pot and (then) I knew my meat and myself.' " The *utkha* spirits had said to him: "Now we are going to cut you up and cook you until you are done. You will lie as though dead, and we will put the meat back and then you will come to life again as a shaman. But we won't be cooking only your meat, so make sure that you know your own meat! If we put back the meat of someone else, something bad will come of it!"⁵¹

But here we return to the question posed at the beginning. Why is it that the vital experience of "what is there," and real "knowledge of oneself" (*byiere tanzhaba*⁵²) implies the loss or suppression of the recognized personality? The marking of the shaman, the incorporation of his body into the *utkha*, giving him the power to enter the other reality whenever he wants, takes place in a transformation of his body that is not merely imaginary: in imagination his body (i.e. his "flesh soul") dies, – that is, it stops being living flesh and becomes raw meat which must be cooked before it can return to this days on end and exists in a state of complete collapse, – he "... lies half-dead, breathing almost imperceptibly, the beating of his heart can hardly be felt, and his hands and face become blue. ..." Neither

⁵¹ G. V. Ksenofontov, *Legendy i Rasskazy o Shamanakh* (Legends and Stories about Shamans), Moscow, 1930, pp. 101–102.

⁵² *Beye* means both the body and the self or personality. The instrumental is often used to mean "oneself," e.g. *shi beyeree yereerei*, "you come yourself." (Ksenofontov uses his own transliteration, but his *byiere* must be *beyeree*).

world; and in fact, the shaman does lose consciousness for several mentally, nor physically, is the shaman "himself" during this period, and this must be seen as another instance of what we noted earlier: if someone is to experience the other reality, he must actually change (by entering a dream or a trance state), so that he is no longer himself.

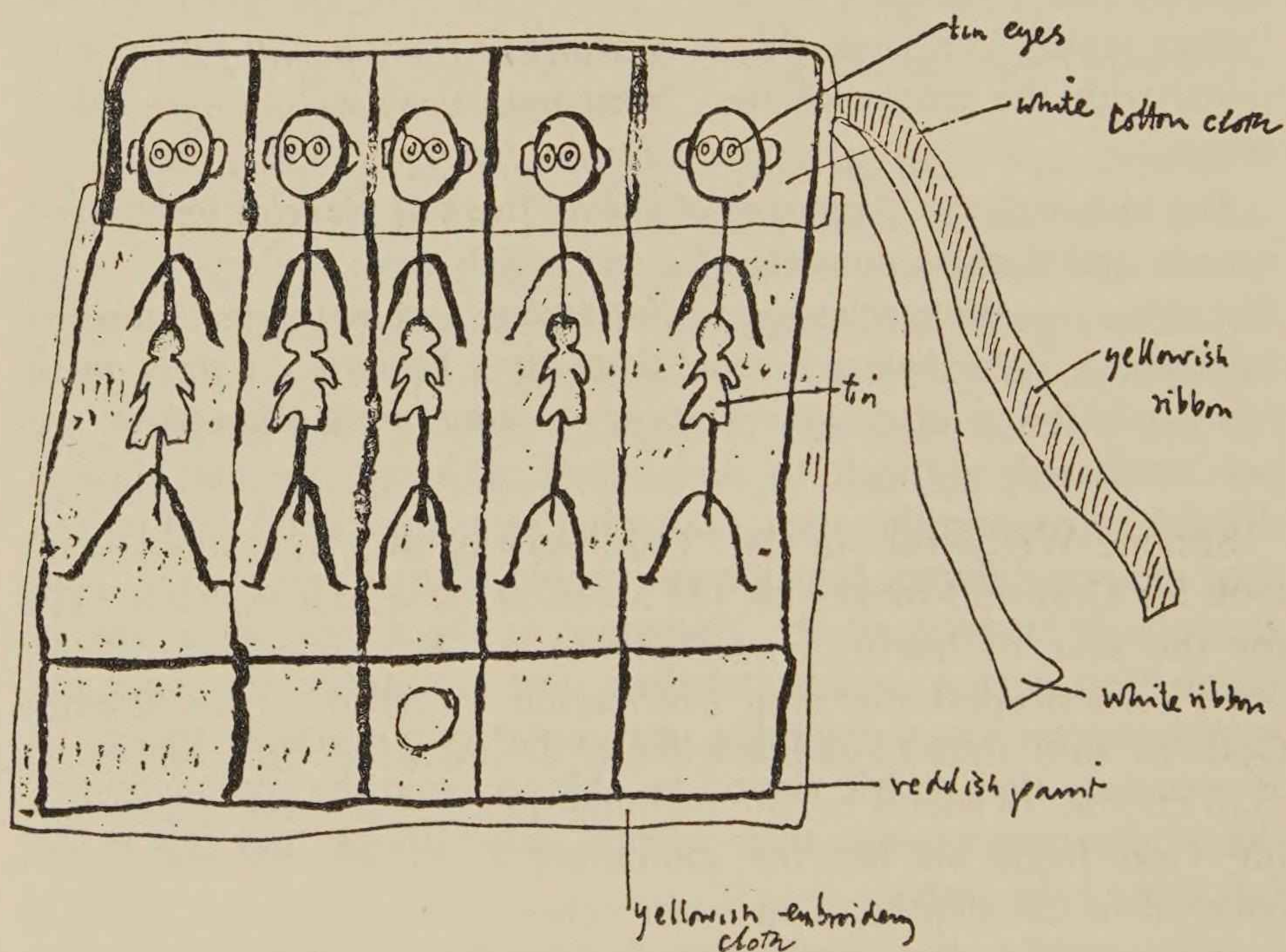
The only explanation of this that we can give here (and it must be a very tentative one) is that this removal of the everyday personality has a function which is associated with the nature of the "other reality" or, since this is expressed in words and representations, with the nature of the "language of spirits" in the widest sense.

But although the "language of spirits" on this plane of formalized speech and actions consists of signs which have undergone some distortion (i.e. the mechanisms of metaphor and metonym described by Lacan), nevertheless it would not be a language if there were not a possibility of communication on some level. Metaphors are not necessarily difficult to understand, although we may find it difficult to explain the nuances of what we comprehend, and indeed they may be different for different people. Thus it seems to me that Buryats do understand the "language of the spirits" in a way in which they cannot understand their own symptoms. But since the spirits express ideas which are unacceptable in everyday society, it is necessary that people should be able to avoid the conjunction of this understanding with their normal personalities, and this is the function of the trance.

Intellectually, this mechanism for regulating certain particular psychological disorders is made possible by the Buryat theory that human beings have several independently functioning souls, giving rise to the ambiguous existence we noted at the beginning of this article.

To sum up: the "language of the spirits" is manifested (a) in physical and psychological symptoms of illness, (b) in formalized speech and actions, and (c) in representations consisting of objects and drawings. It is possible to see a progression here, brought about by the action of the shaman: the spirit appears *first* in the symptoms of the individual, then, after the shaman has made the identity of the spirit known to the patient, in formalized speech, and lastly, after the shaman has sent it out of the human being altogether, in the representation. We have been most interested in the first transformation, i.e. the translation of the spirit from the individual plane of

symptoms to the social plane of formalised speech; this is the point at which the subject enters a trance and loses normal consciousness. Now his understanding of the position changes. No longer is he unfortunately struck down by some inexplicable power; in Freudian terms, he is no longer the subject of inadmissible or contradictory desires which, equally, he does not understand. Now he is in the well-defined and sympathetic role of victim of a certain spirit, against which there are known measures.



An *ongon* of the Kudinsk Buryats dating from the early 1900s. The *ongon* is the material representation of the spirit which has been taken out of the human subject and sent into the drawing by a shaman. This *ongon* has been made with red paint (cinnabar) on two cloths sewn together. The painted figures represent the spirits of five ancestors of the Tanakhaev lineage, the white cloth is the sky and the yellow cloth is the air between the sky and the earth. The small figures cut out of tin represent souls and the horizontal line along the bottom is an altar (*shire*) with a circular offering.

The Epiphany of the Apocalypse

William Davis

(being)

an advent meditation

*a study of the Apocalypse in
unworthy conjunction with
Daniel Berrigan's essay on
"The Book of Revelations"*

*language to be destroyed after
its reading because it is only an
explanation, not a sacrament*

Simone Weil wrote in the "Cahiers" that if a man chooses to look for God and makes his life a conscious search for God (not for the sake of having something to do, but in order to find one's own deepest meaning, recovering the truth), he will find God, or find that God has already found him. Likewise, if a man chooses to spend his life running away from God, in removing God from his life for something better that he has discovered in the depths of his own being, he too, in the end, will find God. It is the man, she says, who sat indifferent in the presence of all possibilities, even the possibility of choosing to not choose in terms of God at all, which is a possibility of finding God in itself, the man who used time as an end in itself to secure his own indifference: this is the man of whom, in the Book of Revelations, Christ said:

These are the words of the Amen, the faithful and true witness, the prime source of all God's creation: I know all your ways; you are neither hot nor cold. How I wish you were either hot or cold! But because you are lukewarm, I will spit you out of my mouth. (Revelations 3.14-16)*

* This quote from Revelations and all quotes included in this paper from Revelations or the remaining books of the New Testament are taken from THE NEW ENGLISH BIBLE, second edition, copyright 1970.

In difference, by its very nature then, does not leave open possibility of history. It is an inability to recognize, refuse, or accept God's gift to man: the ability to direct his awareness away from himself.

There is another aspect to consider before going on in more positive tones. When speaking in terms of possibilities and of their choosing, it is illusory to consider that the only interior possibilities are those of exterior action. Shortly before he died, Thomas Merton spoke at the Conference of Religions of India (Calcutta, 27 October 1968) of how action can become its own subtle kind of indifference, a turning away from a deeper realization of God in oneself which is offered in the silence and solitude, the transcendent emptiness, of contemplative experience:

You will not believe me when I tell you some of the things that are being said – of people going to their priest in confession complaining of their inability to pray. The priest says, "Why pray? I don't pray. Why should you? Prayer is irrelevant. Prayer is medieval. It is immaturity." (You will think I am joking.) "Your action is your prayer and if your action is 24 hours a day, your prayer is 24 hours a day." This is the life of prayer which is relevant to the world. (It is exceedingly dangerous.) In America, even some Catholic theologians have elected to go along with the popular theology – God is dead. The keynote is "horizontal". God is no longer transcendental. He is nowhere else but purely and simply in my neighbor. Beyond this koinetic theology in which, in fact, the traditional view of God has gone and God becomes a very misty reality – over and against that you have a nation like India with its ancient flowering of religious richness of all kinds and possible dimensions. It may be said that the kind of religion which I have been talking about in our America is going to be supremely irrelevant in India; indeed, they are not interested in that kind of thing. India expects Christianity to be open to a dimension of transcendental experience which is denied by these people. Even in America itself you have a whole group of youth tremendously attracted by a deepening of contemplative life and religious experience. I would even say that it is outside the Church – that the place where mysticism is studied in America, is outside the Church in the secular institutions, by the psychiatrist, psychoanalyst not just looking at mysticism under the microscope

but with a sympathetic approach, a whole group of psychoanalysts keenly aware of the fact that mysticism can provide the deepest fulfillment of man's aspirations, and that it can help to form him into a saint. I repeat, this is outside the Church. And you get a funny situation where we, who are endeavouring to practice contemplation, find ourselves cut off from Christian Catholicism and very much in harmony with Zen Buddhism, with artists and poets, the Universities*.

It is necessary to synthesize what we have here into the perspective of history. What we have called so far, in its pure sense, a recording of exterior and interior transcendental experience, requires a deeper dimension. It is important to consider the inmost causes of a man's action and his non-action. It is perhaps not so important to understand every dimension of a cause as to consider it from an apocalyptic perspective, which is a perspective of faith.

In the fifth chapter of Revelations, John sees the book with seven seals which is the book of history; here, the symbolic record of the unfolding of man's dealings with his God, his brothers and himself as well as his environment, by means of his choices and by his indifference. But no one "in heaven or on earth" is able to open the book or look inside it. Here is an impasse – man cannot, by himself, reveal or form the future; he cannot by himself open up his eyes to this capability for self-transcendence that we have called history. He cannot make history on his own. He cannot even be evil (the negative choice) on his own. He can only vegetate in his slavery.

We are then told that it is the Lamb (Christ) who alone is worthy to open the book. Berrigan capitalizes on this point:

Jesus opens history wide. He himself is that book sealed with seven seals, which He alone is worthy to open. Being both God and man, He is both author and subject of history. As author he unseals the book, when all others are helpless to do so. As subject of history, He is victim, wounded, slain, by that same history. That is to say, He encounters the fact of evil by assuming it in His own flesh. He is the Lamb that was both slain and stands again.

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We can only conclude that, without Christ, man is unable once all the structures of indifference he has created to secure his illusion fail (as they inevitably will at an arbitrary point of singular or combined mental, emotional or physical crisis) to believe he really exists (exists in a real world), because he has never had, without Christ, an experience that transcends this trinity of awareness: the mind, the body, the emotions. In the state of indifference, these three constitute a personal universe of sin. Berrigan writes: "Men are unable to reach (on their own) a viable and workable knowledge of themselves. They are literally unable to imagine themselves in the real world; that is to say, of having moral weight, and making a difference there".

This poverty of even a potential for history, this inability of one's own power to transcend oneself, is a kind of hell that regenerates itself because, in its own bounds of awareness and experience, it cannot go beyond man; man cannot go beyond himself. In desperation, rather than turn to life and take the risks of faith, he creates a false history, a recording of indifference and its justifications, which can be done up very well in superficial academic jargon.

This is the kind of history that is studied in our systems of education: war after war after war; this is the foundation that men of indifference build on for the future. And when the need for a historical insight arises, men will logically (and have consistently done so) resort to indifference as the solution of indifference. (War as the solution to war: a war to end war.) It is eminently dangerous.

A viable definition of "history" then would be a surrender to the natural order of life. To make history is to live. To make news, however, is not to make history: it is to exaggerate one or another of the variable awarenesses of man (since we are not all in the universal awareness, i.e., Brahman) and sell it for equally variable reasons: to secure our indifference, to have an enemy, to take a trip (to have an emotional high), to make money. All of which are equal on their own level.

As the desert fathers emphasized in their "verba" and in their style of living, life is not in man's action, but in God's action within man. Truth is not to be found in the extraordinary so much as it is to be found in the un-newsworthy unaction of man that is a prerequisite to God's action; it is a simple metaphor: eliminate some of your own doings so that God can

have a space in which to move. One of the hints of the superficiality of news: the news does not make note of a man's silence, as a rule of journalism, unless it is calculated or designed for public consumption or political games. Pure silence just does not sell.

History, then, life is not to be found or made in the news. It is to be found in the invisible presence of the Source of Life within each man: as Christ says in St. John: "His (the Father's) word has found no home in you." (John 5.38) The word of God, who is Jesus Christ, is not for sale to the journalists. (If it won't sell, the news goes out of business.) But the presence of God Himself within man, offering man a share in His own creation of the real world, that is a renewal within man of the whole cycle of redemption.

If a man does not choose to either participate or not participate, he is left only to that vicious cycle of death and sensationalism that is the sole avenue of creation for those who can choose to make gods of themselves, or their thoughts or their feelings, and pursue the making of endless images of illusion, the false gods referred to by the Apocalyptic prophet simply as "the dead". To make a God of oneself is to be indifferent to the God who is the source of our own Life and the Living of all men.

Life (history), on the other hand, "is revealed to us as an entrance into struggle against the multiple forms of death that affect men and presume to claim him for their own." (D. Berrigan). In an apocalyptic sense, when man has made over himself to his own liking and then given himself over to his idols who will guard those images, he will have created an apocalypse of his own. Berrigan writes about this: "in this secular apocalypse, the end of things is a purely human act wrought in the image of sin". There is no rising after or living beyond this apocalypse; man will have destroyed himself, even beyond disaster. (It may be more than slightly facetious to continue speaking of the Apocalypse in the future tense.)

But, he continues, "Jesus offers an act of God defining the end of things"; in such a case, we men transcend "the end of things" and rise into the presence of God because He has defined the end of everything else but Himself. This is relevant to John's cry at the end of Revelations: "Come, Lord Jesus"! Whereas, when man defines the end of things, he can transcend them in his own secret way, but at the essence of transcendence, he will find only himself (which is not transcendence at all; more

likely, an emotional subtlety), since he has made himself "the First and the Last".

We ask for the coming of the Lord into man; in an apocalyptic awareness, we ask for the beginning and the end of things in us, but as a Christic event; we ask for Him who described Himself: "I am the First and the Last". (Revelations 1.17) We ask for the end to our inherent (or merely contagious through the generations) tendency toward falseness and we ask for birth, the beginning of the presence of life, of the creation of history in us, in order that we may transcend time and language, and see the Truth consuming us with its vision.

History, then, finally reveals its meaning in the Apocalyptic Christ, as being both a beginning and an ending, a birth and a dying, a living of Life by Life in and through man. Let us too pray "Come, Lord!" Let us enter into His advent, especially before we try to swallow Christmas, and find that Christmas has a throat of its own.

* * * *

I think it is important to consider these things now from an expressly self-conscious human viewpoint. It is not complex linguistically.

First, a definition of humanity, very loose: a man is living a human life (his own) when there is a transcendent balance maintained between his working on life and life working on him. It is the whole thing all over again: Christ in us, and we with the vision to see with His eyes. A joint effort then, a personal one and an historical one. It is only the man's transcendent self that is spoken of here, because this is the only self capable of contact with the Life Source: any other self, no matter what it imagines or what it encounters, is incapable, in its own metaphor, of knowing the real presence of Life.

Secondly, the tools with which a man maintains this balance. The tools are time and language. They are the measurements by which a man keeps himself conscious of what he is thinking and feeling and doing. But they are tools which must transcend themselves, and they do not have, in their own abstract way, divine natures. Time and language are, in their natural and pure state not transcendental instruments because they give no part of themselves to mystery, not in a scientific or police sense, but in an apocalyptic sense.

To take language for one : Max Picard, in his book **WORLD OF SILENCE**, says : "It is the spirit that legitimizes speech, but the silence that precedes speech is the pregnant mother who is delivered of speech by the creative activity of the spirit". He also maintains that all language leads to silence. Silence is a mystery, a depth, an abyss where we meet God in our own original solitariness. Silence transcends the logic of language and it is the home of truth, the place to which truth returns when it is freed from the structures of words. It is something that we can enter only as our real selves. It is, ironically by the logic of all this, a mystery. Time, likewise, when it transcends the logic of its measurements leaves only eternity, which is a mystery as well. Reality can never be contained in logic, whether it be mathematical or linguistic. As was said before, a man's wholeness is a transcendence of the intellect. It is an apocalypse all its own : it is the beginning of vision and the end of a need for our logical instruments as ends in themselves.

Then sin. Sin as language. Indifference forces language and time to become ends in themselves, and when these two are forced to become gods, transcendent entities (they can, in truth, only transform men into more mysterious illusions), contrary to their own natures, they turn on man; they control him.

The four horsemen of the book of the seven seals are evidence to all that has been said here of language, time (which is a special kind of language) and sin. The equestrians come and spread their pestilence like omnipotent gods, rooting out the foundations of existence on earth. It is only at the breaking of the seventh seal that we are brought once again into the Lamb's presence and we are faced at that point with this statement :

Now when the Lamb broke the seventh seal,
there was silence in heaven. (Rev. 8.1)

Then follow the plagues of the six angels with trumpets; the "woes" are still only beginning. A third of mankind is slaughtered by "fire, smoke, and sulfur". And yet, even after this, John writes :

The rest of mankind who survived these plagues still did not abjure the gods their hands had fashioned, nor cease their worship of idols. (Rev. 9.20)

Subsequently, the seven thunders do not speak. Thus a tribute to the mystery of the "vision" of Revelations : silence. And after

John eats the book of Truth, about which nothing can be written, he tells of the angels speaking to him :

Once again you must utter prophecies over peoples and nations and languages and many kings. (Rev. 10.11)

And even one last time. When the final beast appears, the final false god, it creates an image of the first beast (of the ten horns and seven heads), and "it was allowed to give breath to the image of the beast, so that it could speak". (Moreover its power lay in the fact that "no one was allowed to buy or sell unless he bore this beast's mark".) Thus the declaration of the very images by which untruth roams our planet, even today : speech, buying and selling. The escape from untruth then, must be in silence, poverty of words.

Berrigan writes: "It is the property of vision to eradicate distinctions between present and future". Therefore let us learn to see truth in what seems to be the darkness of silence. It is that abyss which is the womb of history.

And Berrigan also says : "Apocalyptic time is a mode of consciousness that includes the present and the future, but always embodied". The Body of Christ, the incarnation of the WORD of God is the way into light, the embodiment of history and the perfect consummation of language. In the Eucharistic presence of Jesus, we have the Word, being at once both silence and language, united, brought to perfection and personified in the Son of God, the Son of Man.

Another paradox in all this is that the Apocalypse, the Book of Revelations, like the gospels, is, in itself, language. Here we go one step further into a more sacramental dimension. Poetry is language which contains in it the presence of life : it does not explain life or judge it; it is life in the form of words. The Apocalypse is poetry in the structure of the gospels; therefore, like all poetry, it is a linguistic Eucharist; the Word embodied in words.

Poetry, in itself, is not a relative word; it is a presence. But the word "poetry" as contrasted to "prose" is a necessary phenomenon because prose has become a finger of technology; it explains and judges life's presence in the light of its own false deity. (Explanations and judgments create a distance between what is explained and the writer.) Prose is justifiable only if it leads to silence or to poetry. Prose has become a utilitarian

mechanism. If it were not so, the word "poetry" would be unnecessary. We would have simply pure language, a total poetry, faithful to its nature and purpose as an instrument by which man searches for a vision of truth, a tool to which man, since he is its creator, gives a transcendent dimension, which is, in reality, the same power of transcendence that Christ gives man, transferred to words, since, in a real world, a man identifies with his language. The words of Christ in the gospels then, by the very definitions of a gospel and of "poetry" contain the presence of Christ, the Word of God. When this kind of language is permitted by man to enter his silence, it returns man to the Word of Life.

* * * *

Now we reach a consummation of sorts: the precise reason that history is a good thing to have is that it contains the heritage, the tradition, the presence of God in those who lived (in fullness) before us. History, then, is a sacrament, in an apocalyptic sense. At our beginning of life, we are offered an end to sin, an end to that inherent tendency toward indifference that we call original sin; we are offered fullness of life experienced by those who lived before us. This, in Berrigan's sense, is where we are coming from. We cannot start out on our own, coming from nowhere, and expect to find something worth truth.

If our tradition then is this fullness of life, how do we pass it on without obscuring the fullness, from generation to generation? The answer is first of all in our art. As words in poetry, the various mediums of art are physical structures for the presence of life. To the degree that the artist is open to the Source of Life, the structure he creates will lead men into an abyss of silence where they will meet themselves. The artist's work then reflects his living, his fullness of life and his emptiness of self. When he creates a work of art, he carries on his tradition; he makes history.

There is still another tangent to deal with though in this perspective. It is that the man who sees the work of art may not be able to see. In a Zen-metaphysical sense, he cannot see truth when it is in front of him and cannot not see truth when it is not standing in front of him. (Double negative rule does and does not work here.) Like humanity, then, vision is a twofold potential: first there must be something worthy of sight, and then a man must be able to open his eyes.

Let us switch over again to language. The words, if the writer is true to his art, reflect his vision of truth, give the vision a structure, for the sake of communion with God and with men. The words then are something worthy of ingestion by men; they are a presence for life and so it remains solely with the reader of the words, the communicant, to be open to the vision they present. Berrigan also writes: "the reverse of our proposition is also true: a man can claim to have come from somewhere only if he is going somewhere". Thus, if a man is truly able to grasp the fullness of tradition, he is creating a place for that fullness in himself, he is making history and carrying on the tradition; he is able to see.

Language has been the greatest vessel into which tradition has been poured, and this presents a problem for 20th century man. Because words are now no longer vessels, empty jars ready for fullness. They have been already filled with the enzymes of technology, and any fullness, any history being given to words for the sake of tradition is digested and expelled with a different kind of blood: a technological haemoglobin. And man, having been given the same kind of transfusion via television and the other tools of communication for the masses (i.e., the news) cannot see; has lost his capability for vision. Man must deal with a total blindness that satisfies its own cravings for sight; in short, a monster.

There is for man, though, a sole resort. If a man chooses to expel all falseness from himself, technological and otherwise, he cannot do it through language because language will only lead him into a greater quagmire for the reasons given above. And, of course, a man cannot do it by himself. His sole resort then is silence. It is in silence that the word of God will be spoken to him and he will recover his natural abilities to hear it. It is in silence that his vision will be purified. And it is in silence that he will learn, as Raissa Maritain says in her poem, "The Prisoner", "the language of heaven". And it is in silence that we will begin again to give life to the language of all men and restore the balance of humanity in this world by restoring time and words to their natural level in the order of the world. Finally, it is in silence that our tradition will be resurrected from obscurity, and our potentiality for carrying on that tradition, for making history, recovered. Without silence, we are going to have to face hell, because, having disposed of our tradition, which is the way of Christ, the life of Christ embodied in men's

lives throughout the centuries, we will find we have no place to go.

As was said, history is the presence of God in men, and His action and non-action through men. So, in time, our silence will lead to words of life that lead man once again beyond words, because it is the spirit speaking in the words that redeems us from our own absurd wisdom. And our silence and words will then be a unity.

Christ is our tradition, our "way". He speaks the word of the Father in his Person better than we in our language. In knowing Him, we permit the Apocalypse to be a work of God and not one of man's dreadful folly. And it is in that beginning and ending that the Lord Jesus comes.

Review: *Criticism and the Growth of Knowledge*, ed. Imre Lakatos and Alan Musgrove C.U.P. 1970

I

Professor Kuhn's book of 1962, *The Structure of Scientific Revolutions*, challenged the familiar, one might almost say the consensus, view that science proceeds by the putting forward of hypotheses which are then submitted to the test of experience. His logically central thesis was, and is, that all our experimental findings and observational reports must presuppose some theory, and that therefore they cannot constitute an impartial court of appeal at the bar of which that theory and its rivals might be judged. In other words, it is extremely problematic to ask of any two theories Which does better justice to the facts? because each will have a different view of what "the facts" are. Nevertheless, Kuhn has no wish to deny that preferring one theory to another could be a rational matter – that is, a matter of choice based on criteria. Scientists, in his view, are imbued with certain values – such that they prefer a theory of wider to one of lesser scope, for example, or a theory that is simple to one that is more complicated – values by reference to which choice between theories is typically made.

But the implications of his central thesis do not stop there. They lead to a strikingly distinctive view of the role of theory-choice in scientific activity. To say that any kind of scientific work presupposes some theoretical framework is to suggest that typically at least the scientist works *within* a theory, rather than spending his time, as the falsificationist view would imply, arbitrating *between* rival theories from a point outside them. This is indeed Kuhn's idea. Typically, he argues, members of a scientific community possess a theoretical framework which defines for them the problems to be "solved", what is to count as a "solution" and the methods to be properly employed in searching for one. Normally a scientist spends his time developing this framework – the "established" theory – by widening its scope, and applying it to unsolved problems. He is then engaged on what Kuhn calls "normal" science. The question of choosing between rival theories thus arises in "abnormal" circumstances only: when for some reason (which Kuhn of course goes into)

the validity or continuing usefulness of the framework is thrown into doubt and the "crisis" pattern of rival theories undergoing trial by criticism emerges.

In the present work, these very interesting and important ideas are discussed and to some extent taken further.

II

Relativism

Kuhn's central claim that there is no theory-neutral way of describing experience leads him to one of his most challenging tenets: that the notion of science advancing with time towards a complete knowledge of the natural world is incoherent. We cannot think of successive scientific theories as making ever closer approximations to "the truth" about "the real world", he declares, for the reason that in order to compare two theories with respect to "the truth" we would need to be able to set "the truth" down independently of the theories, which possibility is just what his central thesis denies. "Truth", he is prepared to conclude, must be regarded as a term with "intra-theoretic" applications only (p.266 – here and throughout the reference is to the Lakatos-Musgrave volume).

Surprisingly, Kuhn's critics in this volume have generally ignored this genuine attempt to be a relativist with regard to "truth" and have concentrated instead on attacking a slightly different position which Kuhn does not really hold. Because there is no "neutral observation language", we have seen Kuhn arguing, theories cannot be compared in respect of "the truth": for the same reason there are difficulties in comparing them in any other respect too. Rival theories offer different ways of structuring experience. Either they are couched in different terms or the same terms "apply to nature" differently in the different theories. For a proponent of one theory to understand another he has to "translate" its statements into terms belonging to his own – a task which will be possible, but fraught with the difficulties typical of inter-language translation.

Several commentators have taken Kuhn to be asserting that communication in such circumstances is *impossible*, and have quoted history against him (in the present volume see Toulmin p.43/4 and Popper p.56/7). Kuhn's easy retort is reiteration (p.267).

Nevertheless, two points in Kuhn's discussion need to be cleared up. The first arises out of his insistence that the debate

represented by the present volume constitutes an example of the “incommensurability” of rival theories – in this case the “theories” of science advocated by himself and Popper – and that his task must accordingly be not to put forward facts inconsistent with the rival theory but to bring about a “gestalt-switch” on the part of its proponent. He and Popper agree very largely on “the facts” (“the data”, p.3), says Kuhn; their difference concerns the patterns they discern in them. The idea here is of a collection of “theory-independent” facts or data for which rival theories offer differing interpretations.

But this is quite different from the concept of incommensurability we have seen Kuhn explaining in our paragraphs above. There he is concerned to argue that there is no “neutral observation language”, no “theory-neutral” facts and so no question of rival theorists agreeing on them. It is one thing, in other words, to say that two theories are “incommensurable” because there is no shared way of expressing “the facts” (each being couched in different terms, or terms with different meanings) and quite another to say they are incommensurable because their difference is not over the facts (the “data”) – over which they agree – but over the overall pattern which is discerned in them.

The other unclarity lies in Kuhn’s account of the distinction between theoretical developments which are part of normal science and those which are revolutionary. One would expect Kuhn to hold that the distinction must hang on *conceptual* issues – a theory would be revolutionary insofar as it was “incommensurable” with those it superseded. In fact he indicates that this is indeed his position. But he also asserts the relevance of discovering “the nature and structure of group commitments before and after it [the theoretical development in question] occurred” (p.251). This remark is brief enough; but it does suggest that Kuhn has sociological as well as conceptual criteria in mind for his notion of a revolution, and raises the question of the precise relationship between them.

The Pattern of Scientific Development

On the question of the existence and role of “normal science” the issues are again clouded by misunderstanding. Popper, for example, accepts that the kind of activity Kuhn calls “normal” science does not occur: but it is carried out, says Popper, not by the best scientists but by the second-raters – those who have

been taught badly, to accept dogma instead of to challenge it. "Normal" science is the product of "normal" scientists: science as a whole would be better off without them.

But this simply obscures the basic disagreement. Popper speaks of Kuhn's "normal scientist" and of his "extraordinary scientist". But the contrast Kuhn is most anxious to make out is not between types of scientist but between phases of scientific development. Popper's argument that some scientists fall between the "normal" and the "extraordinary" therefore flails the air (p.54).

His other point, repeated by Watkins, that some sciences or parts of science have not developed according to Kuhn's normal/revolution/normal pattern, is supported by just one clearly indicated example: "the evolution of the theory of matter" (p.54). But as Kuhn points out this is not an example of a *scientific* theory or development at all (p.254/5).

Toulmin's criticism is also based on the premise that Kuhn holds communication between rival theorists is impossible, which we have seen to be mistaken: but the pattern of scientific development he suggests as an alternative to Kuhn's is interesting. Scientific development should be regarded, he suggests, as parallel to biological evolution. A given established theory serves as the origin of a number of "variant" theories, on which "selection pressures" operate and so preserve one variant at the expense of the rest; and then out of this successful variant a second generation of variant theories arises which is subject to selection, and so on. It is however difficult to see how this idea differs in its essentials from Kuhn's: it has the same contrast between the rule of established theory and the multiplication of alternatives, suggests the same enquiries as pertinent to our understanding of science (What governs the number and type of variant theories generated? What determines which of the proposed alternatives shall be successful?). It may be that Toulmin thinks his view distinctive because of the misunderstanding of Kuhn's position (for which he may not be entirely to blame) already referred to.

In replying to his critics on this question Kuhn rather understates his difference with them. He is right to stress the dependence of the concept of revolution on that of normality; right to point out that if his critics are prepared to accept the occurrence of revolutions in the development of scientific thought, they are logically bound to accept that there must be non-revolutionary periods too. Moreover, there must be few critics who would be prepared to deny the occurrence of revolutions; there are none

I think in the present volume. But he is misleadingly irenical I think in suggesting that these points eliminate the possibility of really substantial disagreement in this area.

For one thing, there is the question of what counts as a "revolution". Toulmin was not alone I imagine in understanding (however wrongly) Kuhn's original notion as applying only to the huge conceptual disturbances (such as the establishment of Newtonian physics) which "tended to happen in a given branch of science only once every two hundred years or so" (p.44); and it is the occurrence of this kind of revolution which it would be difficult to deny. But Kuhn makes it perfectly clear in the present volume that his notion of "revolution" is meant to apply not only to such universal disturbances but also to developments on a far smaller scale – he gives Ampère's theory of the electric circuit, Ohm's Law, and Lavoisier's discovery of oxygen as examples; and, moreover, now explains that what may be "revolutionary" for one scientific community may not be so for another with slightly different interests. A critic could therefore quite consistently accept the occurrence of the larger sort of revolution and deny the same status to the smaller changes.

Indeed he could be wise as well as consistent in doing so. For it is this variation in scale of the changes Kuhn wishes to subsume under "revolution", and, parallel to this, the variation in scope of the theories (or "paradigms") which he maintains are changed in the course of them, that strike me as among the most questionable aspects of Kuhn's position. It seems one thing to suggest that paradigms on the big scale define the problems to be solved, what is to count as a solution and the methods to be employed in solving them; but quite another to make the same claim for paradigms on the small scale. We have seen Kuhn make the claim that "truth" is "intra-theoretic", for example. This is problematic even when restricted to theories or paradigms on the largest scale, but it is very much more so in connection with developments of the minor kind now stressed.

It is also possible to disagree with Kuhn's account of how science proceeds between revolutions (whenever they occur). Kuhn says it proceeds by applying an established theory to unsolved "puzzles" and by extending its application in a process of "articulation" (of which more later); but it is not unintelligible to hold that in between revolutions science is prosecuted by scientists putting forward hypotheses and subjecting them to tests.

Although Popper's views on the latter point are well known, where he stands on the former is, as I have hinted, hard to say. Some remarks suggest that he believes in the larger revolutions, but not in what Kuhn regards as the smaller. But then if he is talking about conceptual changes on a really grand scale his claim that "we can break out of our framework at any time" (p.56) is indeed remarkable. Innovation *on this scale* amounts to the elaboration of a new language, which of necessity must be a cooperative enterprise (for reasons developed by Wittgenstein and others); on this ground alone, swapping one framework (in this large sense) for another is certainly not a matter of the whim of the moment, as Popper's remarks suggest (p.56).

Clarification, description and advice

Throughout this debate there runs the perplexing confluence of historical, conceptual and normative concerns. Most of the contributors demonstrate their awareness of it. None, except possibly Kuhn, has anything helpful to say about it.

It is quite possible to distinguish different questions which seem to receive discussion in these pages. As a matter of history, how has science developed up to the present time? (Let us call this problem a *descriptive* question.) If the best scientific advance is to be made, how should scientists set about their business at the present time? (A "normative" question) Is Kuhn's concept of a "revolution" a coherent one? (A "conceptual" question) But to distinguish questions in this way is to reveal the problems, not to solve them. Toulmin is too sanguine when he recommends his own proposals on the grounds that they help "locate the ambiguity . . . between the philosophy of science, which is concerned with the question what consideration *should properly* determine the selection [between rival theories], and the psychology or sociology of science, which is concerned with the considerations that *in fact* settle the matter" (p.46 – Toulmin's italics). Won't the sociologist need to distinguish genuine from bogus science? Is the science student being taught the *philosophy* of science when he is told (correctly or incorrectly) why theory A is to be rejected in favour of theory B? It is sensible to imply that science might *always* as a matter of fact have been pursued wrongly? Toulmin's italics do not help at all with these problems.

Let me emphasize just one important way in which the situation is much more complex than these distinctions suggest. It is indicated by the constant conjunction, so beloved of syllabus

writers, of "philosophy-and-history" of science : there cannot be a philosophically neutral account of science's development. A historian who accepts Kuhn's ideas about the nature of science will acquire a different version of "the facts" from the historian who rejects them in favour of some other. Pearce Williams oversimplifies therefore in suggesting that it is only increased knowledge that will enable us to judge whether Kuhn (or Popper) is right, and in appealing to the image of an "historical foundation" upon which "philosophical structures" might be erected (p.50). We need a conceptual framework through which to understand the development of science before we can give an account of its history, and this is just what (among other things) Kuhn and Popper are (severally) offering.

Kuhn's sense of paradigm

One conceptual enquiry that rather surprisingly receives little attention from the present symposiasts is into the nature of Kuhn's own thesis. Most treat his writings as though they were obviously and perfectly intelligible, and address themselves to the only question that they seem to think arises : Is what he says *correct*?

Miss Masterman is an honourable exception. She has read Kuhn with great care and has pursued the very necessary preliminary question What *exactly* is Kuhn saying? – and in particular What *exactly* does he mean by his crucial term "paradigm"?

Her answer is "Many things", but she picks out one as basic, which she labels the "construct paradigm". It is the application of a "construct paradigm", she says, which makes scientific activity in a particular area possible. For what is needed to initiate such activity, she says, agreeing with Kuhn, is the establishment of a "puzzle-solving" tradition. The field has to be structured in such a way as to present the scientist with a series of problems which can be solved by applying straightforward techniques – "puzzles", as Kuhn calls them, so as to make the distinction between them and the less defined, intellectually obfuscating "problems" having no agreed method of solution which are typical, for example, of philosophy. It is this structuring that is provided by the "construct paradigm".

(Miss Masterman makes much of the fact that the "construct-paradigm" must necessarily be a product of human activity – an "artefact" – though the reason she gives makes me wonder if

I have understood her properly. Since puzzles are necessarily artefacts, she says, artefacts must be used to solve them: and hence the construct paradigm is necessarily an artefact. But according to the only sense I can make of this idea, puzzles can only arise with the imposition of an artefact (a conceptual structure) on a given area of experience and for *this* reason the construct paradigm must be an artefact.)

Miss Masterman then tells us that Kuhn's idea is that the construct paradigm necessary to initiate a puzzle-solving tradition, and thus a period of "normal" science, is necessarily a representation of some already familiar phenomenon. Applying a construct paradigm is therefore a proposal to use a representation of one phenomenon as also a representation of another: the striking of a metaphor. We are given a "way of seeing" the area of experience in question: a picture, for example, of one, familiar, area of experience is proposed as being also a picture of the area that is new. It is the fact that the construct paradigm, and thus the theory with which it is associated, has this dual "concreteness" (it is a representation of *two* fields) that essentially distinguishes Kuhn's view from Popper's, according to Miss Masterman; and clearly she regards this comparison as very much in Kuhn's favour. Her explanation of why this should be so is however rather disappointing. She declares that "quite obviously and in fact" scientific theories have both types of "concreteness", and she gives an example; but otherwise she merely alludes to the arguments put forward by others.

Of these, there seem to be two that command respect. First, only if a theory has associated with it a *model* (Miss Masterman seems content to regard "model" and "construct paradigm" as equivalent, at least in this context) can there be more than guesses when it comes to extending the scope of the theory. For, it is argued, the fact that some correspondences between model and field have been established gives good reason for thinking that others will also hold. Putting forward an hypothesis which postulates such other correspondences is therefore more than it would be otherwise – just a shot in the dark.

Second, any particular set of data can be represented by any number of different mathematical expressions. If however it is accepted that in building a theory for a particular field a model has to be adhered to, choosing among these different mathematical developments becomes possible.

To the first argument it can be replied that we are not bound

to have reasons for putting forward particular hypotheses, and that even if we were, "articulating a paradigm" would not provide them. To the second I think the Kuhnian response would be that the preservation of a consistent model is not always the criterion on which theory-choice is based, as the recent history of physics can be represented as showing. It would then not be true that every theory needs a model to "guide" and "restrict" the theory's articulation, "excising and removing, by the need to preserve it, the otherwise excessive possibilities of abstract development inherent in all mathematics" (p.78). Of course this is the beginning not the end of a debate; but because it concerns Miss Masterman's principal points it is something of a pity that she has not in her paper embarked upon it. (And perhaps this is the place to add that my account of Miss Masterman's discussion may well involve misrepresentation, for which I offer only half an apology: I find her writing consistently – and sometimes, I confess, irritatingly – obscure, and the fault I think is not entirely mine.)

The workings of normal science

Miss Masterman concludes her contribution by addressing a problem which Kuhn himself pursues in his closing paper. How does normal science proceed?

Normal science, both agree, consists of two processes: the application of a given theory to new problems of the kind it has already been successful in solving, and the extension of the theory to cover new *kinds* of case. The second process, with which Miss Masterman deals, she regards as continuing articulation of the original construct paradigm with experience. When a paradigm is first applied to a given field many of its features are ignored; but once the initial proposal has established itself the possibility of further correspondences (involving these hitherto "unused" features of the paradigm on the one hand and unmapped areas of the new field on the other) can be pursued.

The principle involved, says Miss Masterman, is one of "replication": the scientist is attempting to build a system which "replicates" the "main features" of the new field. It apparently proceeds by the scientist's "intuition"; but Miss Masterman suggests two types of mathematical treatments which may be at the bottom of the mental computation which must, she thinks, be involved.

The first is the technique used in numerical taxonomy (as

well as elsewhere) to sort a congeries of individuals into groups of "overall similarity"; the other is a technique which enables one to pick out from a set of individuals the one that is "most like" a given individual outside the set.

Miss Masterman says very little about these suggestions, but one comment is I think in order. Both approaches rely on the possibility of treating the individuals to be compared (paradigm on the one hand, field of experience on the other) as though each possessed a fixed and definite number of characteristics (Miss Masterman, p.86): But this assumption cannot properly be made. An individual can always be described in a number of different ways, and each way divides it up, as it were, into a different set of characters. There is no such set, in other words, as *the* set of characters possessed by a given individual. (It follows from this that the approach to classification known as "numerical taxonomy" to which Miss Masterman refers is founded on a mistake, a conclusion I embrace and further defend in my forthcoming "Numerical Taxonomy".)

Kuhn's account of the other aspect of normal science, the application of an established theory to problems of the type it has already been successful in solving, also turns upon a similarity relation: how does the scientist pick out a new problem as "similar" to those already solved?

It is a mistake (in fact the *fundamental* mistake made by the falsificationist), he explains, to think that a theory embodies criteria which allow all empirical eventualities to be classified into those that would confirm the theory, those that would falsify it, and those that would be irrelevant. The truth is that the theory itself typically leaves unsettled the question of whether a particular instance falls under it or not. What the scientist has, instead of rigid and unambiguous rules specifying the relation between the theory and all possible experience are the actual concrete applications the theory has had in the past; these, acting as "paradigms" (now obviously in a sense different from that of Miss Masterman's "construct paradigms"), enable the scientist to develop an idea of what counts as "similar" situations for the theory in question and so to judge when it applies and when not.

In Kuhn's view, the basic process here is central both in acquiring current scientific knowledge and in research. The student, as two aspects of but one activity, learns about the behaviour of the world at the same time as he learns the

meaning of a given theory's terms: and both by (among other ways) familiarizing himself with the concrete cases in which the theory has been successfully applied. The research worker, in establishing new facts about the world at the same time and by the same stroke applies a theory to a new situation, a situation which he discerns as "similar" to those to which the theory has been applied successfully in the past. In both cases Kuhn stresses that the ability to judge "similar" situations (in relation to the theory in question) is acquired by becoming familiar with exemplary problem solutions. But we cannot, he goes on, be content to describe this ability as an intuitive one. Like Miss Masterman, he sees the necessity to provide an account of the logical principles which underlie the scientist's intuition. I have not unfortunately been able to consult the paper where he begins to outline such an account ("Second Thoughts on Paradigms", in Frederick Suppe (ed.): *The Structure of Scientific Theory*, 1970) and he says very little on the point here; but the project has great interest for philosophy in general, promising, as it does, to make something rigorous of the very important "family resemblance" theory of general terms.

III

This volume, which consists, perhaps we ought to record, of papers by Professors Kuhn, Watkins, Toulmin, Pearce Williams, Popper, Miss Margaret Masterman and Professors Lakatos and Feyerabend, is represented as the written record of the part of the 1965 International Colloquium in the Philosophy of Science held at Bedford College in London. No debate, one might remark, could ever have stood in greater need of the "rational reconstruction" proclaimed in the preface (and elsewhere). Of the three planned main speakers Professor Feyerabend "could not come", Professor Lakatos did not have time to finish his paper and Professor Kuhn, trapped at the last minute into producing a statement instead of a reply was obliged to advance his schedule and rush his paper over the Atlantic a paragraph at a time to an anxiously waiting Professor Watkins, who had rashly agreed as a stand-in to prepare a response in the handful of weeks that remained (p.25). Who can say that the bare record of history on this occasion should have come before the public unclothed?

And yet the editing is not without its touch of the bizarre. It might not matter that by far the biggest contribution, by

Lakatos, did not figure in the original debate at all; but it matters rather a lot I think that it should be announced as a *crude* version of a book *already* published separately (p.91). This is part of the reason for its neglect in the present review. Then again, although almost five years elapsed between the symposium and the publication of this written record – time enough, as I say, for some papers to be “rationally reconstructed” out of the thin air – of the other contributions at least one bears all the signs of the impromptu (I am thinking of Popper’s, and particularly of the extraordinary cluster of ill-assorted remarks that constitute his peroration).

In philosophical quality this work is variable. Several contributors are prepared to criticise where they have not read carefully enough. One is even prepared purposefully to mistate a position in order to make it susceptible to attack (Watkins, p.29). Emotional rhetoric and quite unhelpful factionalism intrude more than once. I agree with Miss Masterman’s first footnote on p.61, though not with her idea that it justifies (milder) intellectual thuggery on her own part. But there is plenty of careful and stimulating thinking too, particularly in the papers by Lakatos, and Miss Masterman – and in the two papers by Kuhn himself, which are superb.

Vernon Pratt

Comment:

Energy transducing in the brain: Needham on Chinese Culture

Your cover design for January 1971 was of particular interest, since it shows the influence of a remarkable little book (*A Rhythmic Approach to Mathematics*, London, George Philip & Son, 1906) in which two remarkable women co-operated: Edith L. Somerwell who wrote the text and Mary Everest Boole (daughter of George Boole) who wrote the preface. These ladies were instrumental in adopting for children a fascinating method of creative design, as comparison of your January 1971 cover design with their plates (II3, VI, III2, XIXa(8), XIXb(a), and XXIIa) shows. The last two were both designed and worked by children, the last one being done by village children in Norfolk.

Your first sentence on page 3 (Jan. 1971) very ably and succinctly summarizes my own conclusions as to the fruitful way to investigate dowsing, and psychometry as well, which must be closely related to dowsing, and of which there also exist remarkable case studies.

What my researches have particularly sought (by techniques that include logic as well as what may be called exotic, i.e. unfamiliar, algebras and their arithmetics, together with their inherent meta-geometries) has been the *energy transducer* that mediates between the self and the brain. (Note the difference between the two as brought out, for example, in the fine article you published by a brilliant mind whose body had suffered a grievous brain stroke.) Since we now know that the brain works by molecularly based micro-electromagnetic field changes, this transducer must be such that it converts a volition into a tiny bit of electromagnetic energy, so as to trigger a desired sequence of biochemical and biophysical events culminating say, in the act of raising one's hand to do something or focusing one's eye to read, or moving one's legs and feet to walk or run. The nub of the matter is in the initial triggering or directive energy at key points in the brain. That such energizings are evocable at will is, of course, the common experience of every person in his right senses.

My work shows that the first bodily (and small) energies mobilized by this tiny triggering spark transduced from volition are the free energy packets (principally the so-called London forces) required

and known to exist in all organisms by modern quantum biology. I have written a more technical paper on the nature of the process by which these at first randomly distributed indeterminate energies would be focused and directed, i.e. giving a distribution more like that of an impulse than a Gaussian spread (see p. 75 ff., *The International Journal of Bio-Medical Computing*, January 1970).

Speaking as a former resident of the Middle East and Europe for ten years, and as one who has lived in Asia and Africa, my reactions to Joseph Needham's piece on Mao-tsê-tung were mixed, for I deeply share the author's ideal of man not engaging in subjugation or debasement of his fellows. Dr. Needham, however, glosses over the failures of Marxism in achieved (post-Revolutionary) practice to do anything but ape a giant, monopoly capitalist corporation, cartel, or corporate farm called "the State" or even more incorrectly "the People".

As Walter Roberts so well said in *Theoria to Theory* (January 1971, page 6): "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." Mao's is even not so secular. He is an Asiatic *hutuktu*, to use the Mongol term, "a living god", as were some of the emperors of decadent Rome.

If we regret the depersonalization effected by modern technology in capitalist countries, we must regret even more its intense magnification in a marxist-type state-cartel, where there is on principle an utter neglect of every individual as such within it except its Maos – the Party clique, a parasitic in-group who write poems and live high on the hog (doing token bricklaying as capitalist officials lay cornerstones on occasion) – while the masses toil for Mao's imperial glory and celebrate his adored personage in the form of his image or his picture or other ikon, when the August Presence is not there.

Needham has also schizophrenically forgotten that it was Maoists who desecrated Confucius' grave and that when Lao-tse spoke of *Tao* it was not physical nature or even Nature with a capital initial, but an all-immanent all-transcendent merciful and compassionate power that could be termed nothing less than divine awareness, though most remain unaware of it. "Though despised of men I am comforted by my Mother Tao" wrote Lao-tse. "I am among men like an infant who has not yet smiled . . . I am called foolish (by the worldly energetic)." This is not Maoism in any shape or form – but reminds us much more of him who once said "foxes have their holes, but the Son of Man has nowhere to lay his head."

Needham's argument is vitiated by his obvious misconception of Taoism. What he misrepresents as Taoism appears to come from Maoist pamphlets rather than from the *Tao-teh-ching*. Moreover, Lao-tse taught, as most central to his enterprise, the doctrine of individual survival after bodily decease and also of the definite possibility within the scheme of things that men as individuals could attain immortality even before death, with the development of a miraculous body not of our matter.

Chapter 54 of the *Tao-teh-ching* contains the old character chen (also found in Chuang-tse, as well as in Chinese alchemy in the best Jungian sense) used to denote the process by which man could achieve individual immortality. The oldest Chinese dictionary, the *Shuo Wen*, clearly explains that character. But it has not been hitherto noticed that it occurs in Lao-tse, which has occasioned mistranslation. The passage in question, the 4th sentence of Ch. 54, correctly translated, reads:

Who cultivates Tao in his body will attain the Teh (power associated with Tao) of immortality.

We have seen this sentence bowdlerized into "cultivate Tao in your person and its virtue will be genuine", or even worse, "accept Tao in yourself and Teh is yours", and, now utterly garbled, "realized in one man, fitness has its rise".

It is a pleasure to say that the drawbacks reviewed above did not so vitiate the second article by Joseph Needham in *T. to T.*, volume 5, second quarter, in which he becomes more removed from the source of his intense bias, and in the same measure very much more refreshing and reliable.

On page 76 he reaches a high point of insight when, influenced by Walter Pagel, he stresses our regaining "that realm of Hermetic inspiration and idea-sources . . . so important for the history of thought". However, on p. 72 he again lapses into the systematic error of his characteristic and logically dangerous assumption that Chinese culture was indigenously produced in effective isolation. In particular, Needham consistently neglects the powerful influence of India on Chinese philosophy and belief, as well as the interrelations of Iranian and Sumero-Babylonian culture with Indian culture thus passed on to China, let alone the influence of direct embassies in pre-Christian times from Europe to Imperial Chinese provinces, e.g. that from Rome to Hanoi. This is shown by linguistic-scriptural evidence in the former instance and in the second, by the ancient Indus Valley seals found in Mesopotamia (and vice versa for the

Indus Valley sites). Thus on p. 72 (*T. to T.*, vol. 5, no. 2) he writes: "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" (italics ours).

First, the Chinese elixir of life was Taoist, and hence not materialist. The immortal body it led to was no longer matter in any sense we know – being now able to be undamaged by any of the natural elements, including fire, and being able to teleport, and to permeate walls. We thus revert to Needham's deep misunderstanding of Taoism. Furthermore, the elixir-of-life concept came to China by way of the ancient Vedic *soma* tradition of the divine plant of immortality. That tradition in turn has common roots even further west in the Sumero-Egyptian concept of the plant-based elixir of life, shown even in the bas-reliefs of later Assyria in the hands of gods, and featured in legends of the goddess Isis of Egypt where, as in India, the elixir of life was linked with a concept of a higher kind of energy called the fire of life, which reappeared in later alchemical thought. Paracelsus and Roger Bacon had their sources not in China, as Needham so farfetchedly strains to allege, but in the Egypto-Babylonian Hermetic tradition and in the ancient Hindu Iranian Aryan traditions fused with it.

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Participation by Public Inquiry

Timothy Aldworth distinguishes between participation on a political level and participation in planning at a technical level. A distinction of another kind is between constructive participation in a local authority's development plan and participation by objection to a planning proposal in which early participation would have been impossible. The Skeffington Report was concerned only with the first of these. From the earliest days of these development plans the more progressive local authorities have tried to engage public interest, though others have waited until they were so deeply committed to a particular set of ideas that they were inviting *comment* rather than participation. But the 1968 Planning Act now *requires* local authorities to invite

participation at an early stage from "persons who may be expected to desire an opportunity of making representations", described in Skeffington more colourfully as "... the active minority, the yeast of the community". Skeffington also discussed ways of involving the interest of those outside this circle, – as "... those who do not join societies or attend meetings".

Whether people should be hounded into participation is perhaps questionable. Local authorities could perhaps put the equivalent effort into improving their schools, so that the next generation would all join societies and attend meetings. However, this will not be in time for the new Structure Plans under the 1968 Act which are expected on the Minister's desk within a couple of years.

But development plans are only one side of the planning coin; moreover they are finite in number, since the number of plans cannot exceed the number of planning authorities, and they only occur at intervals of many years – though amendments to them are more frequent and can be complicated. On the other side of the coin are innumerable day-to-day planning decisions, unpredictable in number and importance, in which the public could not possibly have participated in their early formative stages – for example in the plan of the Shell Company to erect a North Sea gas terminal on the Norfolk coast; of the Gas Council to put a gas-holder in the middle of Abingdon; of I.C.I. and the Water Board to build a reservoir in Upper Teesdale; of the Central Electricity Generating Board to site a power station in a green belt; or of Richard Thomas and Baldwins to extract ironstone from the countryside near Banbury.* In these cases the public can only object, but the public inquiries at which their objections are heard are one of the great democratic devices of our time.

But "objection" in this context is not necessarily a negative or unconstructive exercise. Corporate objectors usually freely admit at the inquiries that the proposed development has got to take place in one form or another, and produce alternatives which will do less violence to the interest that they represent. Naturally what they suggest is going to harm someone else's interest instead of their own, but part of the object of the inquiry

* These five examples have recently been examined in great detail in a volume of case studies. *The Price of Amenity – Five studies in Conservation and Government*, by Roy Gregory, published by Macmillan in 1971 at the regrettable price of £8.

is to discover how to do the least harm to the smallest number, and it is the inspector's task to weigh one claim against another in making his recommendation. In other words objection may be a form of delayed participation. Some years ago, for example, the CPRE, the National Trust and local amenity societies spent considerable sums on commissioning engineering consultants to design an alternative scheme for supplying water from Ullswater to the City of Manchester; and in the recent London airport inquiries local pressure groups have done much the same on a remarkably large scale.

These open debates on the environment, for that is what they now amount to in practice – even though it is far from their original purpose – may be launched in various ways. They may be appeals against the refusal of a local authority to give planning permission. They may be inquiries into objections to the plans of a private developer or of various statutory authorities exercising “deemed planning permission”; in the latter case the holding of a public inquiry may be mandatory but is more often discretionary. As a kind of back-stop the Minister may “call in” a planning application if it seems sufficiently important or controversial, and decide it himself in the first instance instead of merely being a possible court of appeal; in fact he does this about a hundred times a year. Occasionally the Secretary of State for the Environment himself may be a developer, though broadly speaking this only happens with new towns and trunk roads or motorways.

But whatever their statutory origin planning inquiries may quite possibly ensure that the will of the *minority* prevails, to the greater good of posterity maybe, but raising fascinating questions about the nature of democracy. Is the environment to be managed by counting heads? Ought members of local planning committees to reflect the wishes of their constituents or, as in Parliament with capital punishment, to make up their own minds? Ought self-appointed and unofficial pressure groups, almost always a small minority, be able to influence decisions as much as they do? In the last resort, ought the Minister to be able to overrule everybody, where Parliament has devolved planning decisions in the first place on elected representatives? These things are happening all the time in various guises.

The smaller local authorities, such as borough councils with delegated powers, must be concerned with local trade and rateable values, and their members tend not to be elected for their

aesthetic judgement or knowledge of the fine arts. They may properly prefer a supermarket to an eighteenth century facade, and the new buildings they approve may be distressing to the local preservation society. But if the matter goes to inquiry and the proposal is defeated a minority will have prevailed over the wishes of the elected representatives of the people. Conversely a local authority may itself be the guardian of the minority view. A few years ago the Derbyshire County Council refused permission for a motor racing circuit in a semi-rural area, and were upheld on appeal by the Minister; but the scheme was popular locally and a referendum would almost certainly have approved it.

A case of some complexity arose in 1968, when a private developer applied for planning permission to build a holiday and sports centre in the Vale of Appleby in Westmorland – dormitories, restaurants, sports hall, ice skating rink, gymnasium, theatre, night club, yacht basin *et al.* The Westmorland County Council, the North Westmorland Rural District Council and the Appleby Borough Council approved the plan in principle, since population and prosperity were declining and there was urgent need for new employment. Individual landowners and tenant farmers objected, as did the amenity societies. The Ministry of Agriculture objected to the *amount* of land to be taken, but were not concerned to oppose on other grounds.

The Minister's inspector supported the local authorities' views in principle, though extraneous reasons compelled him to recommend against the application as then put forward; he specifically recommended, however, that this should not stand in the way of a fresh application when certain other matters had been resolved. But the Minister did not accept his inspector's recommendations*, thus overriding the opinion of three sets of elected representatives and his own quasi-judicial officer. What kind of democracy is this? To anyone who has climbed the heights of Upper Teesdale (reservoir or no reservoir) to the strange depression in the Pennine chain known as High Cup Nick, from which to look down on the delectable valley of moorland, farm and woodland, where this horror was to be sited, an excellent kind of democracy. But can the local people, wanting jobs for themselves and their children, be expected to see it like this?

* In 97% of the cases the Minister *does* agree with inspectors' recommendations.

In situations of this kind a great many interests are in conflict, and not all of them show above the surface. Some people find noise, litter and mass enjoyment acceptable; others, maybe a small minority, find them intolerable. Some put employment and family security above all else, others want to preserve a vanishing countryside, some of them having reasons just as sentimental, selfish, or, if in the tourist trade, financially hard-headed as their opponents. Conflicts of this kind come into the open at local inquiries, but in the background are conflicts of another kind which must eventually be resolved by political decision. The people of Westmorland, or those who want to preserve Westmorland, see the problem as it affects Westmorland. The Secretary of State in London has got to consider how much scenery, or history or wild life (to say nothing of agriculture) there is in the country altogether, and to weigh up not only the arguments which are filtered through his inspector but the views of the national electorate as well as the effect on posterity, who can only inherit what this generation leaves to them. For "Whitehall" is not mindless of this ultimate responsibility. In rejecting everybody's advice the Secretary of State, also indirectly chosen by the electorate, may be fulfilling a democratic role as conscientiously as the local councils are fulfilling theirs.

The fact that the public inquiry is now a means of public participation in planning is due to the way the public has taken hold of a legislative provision and turned it into something that it was never intended to be. The intention of Parliament was to give an opportunity to a very restricted group of people, personally and immediately affected by a proposal, to state their objections. By a distinction of theological subtlety, objection was to be confined to the plan and was not to extend to the policy behind the plan; third parties, which includes the entire amenity lobby, had no rights, and indeed have none to this day. All this was made clear in the evidence given by the Ministry to the Franks Committee in 1957. But since then public opinion on the environment has gathered such strength that it has simply rejected the purposes of the Act and substituted its own, so that fine distinctions have ceased to mean very much and everyone who has anything to say is allowed to say it. Third parties still have no legal rights* but are accorded generous opportunities by administrative concession. Frequently a Minis-

* Except in a limited number of so-called "bad neighbour" developments, where offensive smell or noise may be involved.

ter is not obliged to hold a *public* inquiry at all – his statutory obligation stops at providing “an opportunity to be heard by a person appointed by him for the purpose” – but almost invariably prescribes a public inquiry. In other cases he is only obliged to hold an inquiry of any kind, public or private, if objection comes from certain public authorities; private objectors, including amenity societies, have no *right* to a hearing. But a public inquiry is not refused either when public opinion has presented organised and representative opposition, or when an objector, influential or not, has raised a point that had not previously been considered. The Secretary of State is concerned only with the *quality* of an objection.

This change in the scope and purpose of public inquiries, with no corresponding change in statute law, is a remarkable example of how organised public opinion can influence the process of administration. An opportunity to justify an objection to a proposal has gradually developed into a discussion of the need for it and criticism of the manner in which it is being satisfied.

A corollary of this change has been that planning inquiries have become public debates, and the Planning Bar a prestigious branch of the profession of advocacy. This has not always worked to advantage, for it has tended to make public inquiries too much like the courts. Procedural rules for inquiries are admittedly much simpler than court rules, and the inspector, unlike a judge, can take into account the evidence of his own eyes when he visits a site. But too much is heard of “evidence”, and many important matters are not put in evidence at all. For example, the decision to permit a natural gas terminal on the Norfolk coast may have been justified in itself, but it did not take into account – there was no evidence – future developments which might mean that it had to be extended to an unacceptable point*. Or again, although inquiries are fair and inspectors are widely praised for their discrimination and impartiality, it is undeniable that wealthy and articulate interests have an advantage over others. Even today the strength of the pro-airport factions at the London Airport inquiries is not known, and it is doubtful whether justice was done to it in evidence.

Accordingly there has been a tendency to supplement the

* This actually happened. A 175 foot high chimney, expressly excluded from the Minister's planning consent, had later to be erected.

“adversary” procedure of the British courts with the “inquisitorial” procedure of a Continental examining magistrate. The Roskill Commission, for example, although it listened to lengthy advocacy, was also free to range wherever it liked in search of information – within its admittedly limited terms of reference; and there is a (so far unused) provision in current legislation for a “planning inquiry commission”, with powers somewhat resembling those of Roskill, when the proposal that is to be examined raises new or difficult scientific or technical problems, or when “considerations of regional or national importance” are being raised. One of the most common difficulties about public local inquiries is that what they are discussing is not really local.

Meanwhile the Development Plans, with which we started, have also run into difficulties. The public inquiry into the Greater London Development Plan, which started in October 1970 and is still going strong, is a test of physical, intellectual and financial endurance, and this is made more burdensome by countless individuals and groups repeating one another, or taking up the Panel’s time with matters which must inevitably be regarded as minor in the context of the Plan as a whole. So now the Government, with an eye on the spate of Structure Plans which may be expected in 1972 and 1973, are proposing to give the Minister power to be more selective in deciding to whom he should listen*.

There is another problem here. We seem to have elevated a largely discretionary provision in an English Act of Parliament to the status of a fundamental human right. Is it essential to our kind of democracy that everyone shall be able to come to an inquiry and say what others have already said? Can we not distinguish between “evidence” that is a statement of personal grievance and that which is a contribution to a solution, and should not the two be dealt with in different ways?

This is only part of the larger problem of adapting the way we conduct major planning inquiries to the complications that they now encounter – complications scarcely imagined by the Franks Committee when they first took a long look at “administrative procedures which may involve a public inquiry” fifteen years ago. In some respects the old 19th century Private Bill has advantages, and in a recent case it was more favourable

* Town and Country Planning (Amendment) Act 1971, section 3.

to the objections of the protection lobby than was a comparable public inquiry*. But no-one would claim that participation was among its virtues, for only those who can afford to brief parliamentary counsel can get a hearing; and so far no-one has been able to suggest how to improve public inquiry procedure without prejudice to the individual rights we have come to take for granted.

Perhaps the public hearings of the Roskill Commission may have provided a clue, for they mixed up the "adversarial" and "inquisitorial" elements. Learned counsel spoke on behalf of their clients – the objectors – but from time to time members of the Commission, themselves expert, addressed questions direct to expert witnesses, whose language they understood better than counsel who were attempting to interpret it. The Commission thus combined hearing objections with getting at basic facts.

It might be better if expert were to speak to expert, whether in public or private, in order to clear as much ground as possible *before* objections were considered, though it could be obligatory for them to consider written representations from any quarter. Public inquiries, hearing both objections and counter-proposals, could then follow the publication of their advice, objectors having to satisfy a credentials committee either that they represented a substantial organised interest or that their objection or counter proposal had not already been taken into account. This would be less than democratic, as the word is commonly used, but it might be better to be undemocratic than to seize up, and we would still be giving people more of a say than almost anywhere else in the world. The Department of the Environment may be a bit authoritarian, or paternalistic; but no other country in the world goes to half the trouble. Foreign visitors to the Council on Tribunals are dumb with astonishment at the way the public is pampered!

The trouble with planning controls is that their success lies in what has not happened, and what is therefore not easy to demonstrate; the failures, and the bad cases that have been allowed to slip through the net, are all too obvious. But planning legislation in general and the public inquiry in particular have arrested a potential slide into squalor, and have given the public a fair chance both to participate and to protest – at

* A proposed reservoir in the Calder Valley (private bill) was rejected by Parliament but a power station in the Snowdonia National Park (public inquiry) accepted by the Minister.

least, where local planning authorities have played their part properly. And below the mountain peak inquiries into airports, motorways, power stations, reservoirs, and mining and drilling operations there are, in the foothills, a score of inquiries taking place every day of the year into footpaths, garages, filling stations, turning houses into shops, unsightly advertisements, preservation of buildings and a dozen other matters. They represent thousands of hours of patient investigation in which claims are delicately balanced – those of the individual against the community, of commercial progress against aesthetic preservation, of short-term benefit against long-term advantage. Without them the quality of our national life would be a good deal more depressing than it is.

Ronald Wraith

The Green,
Widdington,
Saffron Walden.

Sentences: *Gloucester Moors.*

William Vaughan Moody

A mile behind is Gloucester town
Where the fishing fleets put in,
A mile ahead the land dips down
And the woods and farms begin.
Here, where the moors stretch free
In the high blue afternoon,
Are the marching sun and talking sea,
And the racing winds that wheel and flee
On the flying heels of June.*

*Jill-o'er-the-ground is purple blue,
Blue is the quaker-maid,
The wild geranium holds its dew
Long in the boulder's shade.
Wax-red hangs the cup
From the huckleberry boughs,
In barberry bells the grey moths sup,
Or where the choke-cherry lifts high up
Sweet bowls for their carouse.*

* * * *

*This earth is not the steadfast place
We landsmen build upon;
From deep to deep she varies pace,
And while she comes is gone.
Beneath my feet I feel
Her smooth bulk heave and dip;
With velvet plunge and soft upreel
She swings and steadies to her keel
Like a gallant, gallant ship.*

* * * *

* Gloucester is on the coast of Massachusetts.

*God, dear God! Does she know her port,
Though she goes so far about?
Or blind astray, does she make her sport
To brazen and chance it out?*

*I watched when her captains passed:
She were better captainless.
Men in the cabin, before the mast,
But some were reckless and some aghast,
And some sat gorged at mess.*

*By her battened hatch I leaned and caught
Sounds from the noisome hold,—
Cursing and sighing of souls distraught
And cries too sad to be told.
Then I strove to go down and see;
But they said, "Thou art not of us!"
I turned to those on the deck with me
And cried, "Give help!" But they said, "Let be:
Our ship sails faster thus."*

*Jill-o'er-the-ground is purple blue,
Blue is the quaker-maid,
The alder-clump where the brook comes through
Breeds cresses in its shade.
To be out of the moiling street
With its swelter and its sin!
Who has given to me this sweet,
And given my brother dust to eat?
And when will his wage come in?*

*Scattering wide or blown in ranks,
Yellow and white and brown,
Boats and boats from the fishing banks
Come home to Gloucester town.
There is cash to purse and spend,
There are wives to be embraced,
Hearts to take and keep to the end,—
O little sails, make haste!*

*But thou, vast outbound ship of souls,
What harbor town for thee?
What shapes, when thy arriving tolls,
Shall crowd the banks to see?
Shall all the happy shipmates then
Stand singing brotherly?
Or shall a haggard ruthless few
Warp her over and bring her to,
While the many broken souls of men
Fester down in the slavers pen,
And nothing to say or do?*

William Vaughan Moody

NOTES ON CONTRIBUTORS

Irene Manton F.R.S., formerly Professor of Botany and head of the Botany Department at Leeds University, is a cytologist who pioneered the application of electron microscopy to the study of fine structure of plant cells. She is a gold medallist of the Linnaean Society, and author of about 150 scientific papers and one book, *"Problems of Cytology and Evolution in the Pteridophyta"* C.U.P. 1950.

Sir Frederick Warner is a consulting engineer, with special knowledge of pollution control. He combines industrial work around the world with chairmanship of a variety of Government committees. He is Visiting Professor at Imperial College, and at University College, London, in Environmental Design and Engineering. He is Chairman of Council in the School of Pharmacy and Vice-Chairman of Council in the Open University, and has just retired as President of FEANI, the European Federation of National Associations of Engineers.

Mary Osborn studied Physics at Cambridge, then decided she was more interested in Biology, and did postgraduate work both at Pennsylvania State University and at Harvard. She is now working in Cambridge.

Caroline Humphrey (née Waddington) took a degree in Archaeology and Anthropology in Cambridge and has done research at Moscow and Leningrad Universities and St. Anthony's College, Oxford. She is just taking up a research fellowship at Girton College, Cambridge. Publications: *"Some Ideas of Saussure applied to Buryat Magical Drawings"* (ASA Monographs X) and *"Simvolicheskie aspekty razvitiya buryatskogo zhilishcha"* (Tezisy dokladov Institut Ethnografi an SSSR, Moscow, 1971).

William Davis writes poems and has been making an English Translation of the French poems of Thomas Merton, to be published by New Directions next year in Thomas Merton's Collected Poems.

Vernon Pratt turned to Philosophy after a false start in Botany. He went from Manchester to Oxford and now teaches at University College, Cardiff. Last year he spent in Nigeria at the University of Ife where he was Visiting Lecturer. His book (let) *Religion and Secularisation* was published earlier this year, but his serious interest at the moment is in the philosophical issues in Biology.

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