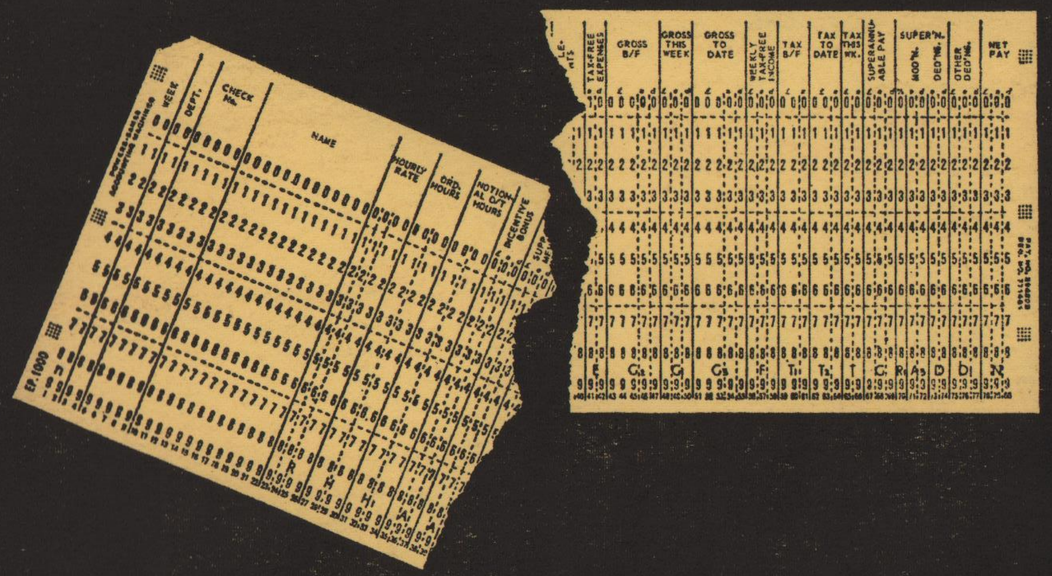
Politics of the upright man, by Richard Drinnon in Anarchy next month

TECHNOLOGY SCIENCE AND ANARCHISM



ANARCHY 25

A JOURNAL OF ANARCHIST IDEAS

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Technology, science and anarchism: 1. Homo Aedificans

HARRY BAECKER

IT HAS ALWAYS BEEN A GREAT TEMPTATION to give an intensive definition of man. Our ancestors were so bemused by their own philosophical capabilities, and by the, to them, evident lack of these in the rest of the fauna that they characterised themselves as *homo sapiens*. You and I have inherited that noble appellation without any effort on our part. Of late we have had other attempts at definition, *homo ludens* by Huizinga, "man the time-binder" by Korzybski. The former emphasised the importance of non-purposeful activity, play, in the development of those activities we consider more worthy and important; the latter characterised man by his ability to symbolise experience and thereby transmit it to other members of the species far distant in time and space. Korzybski's definition is, by the way, extensive, as given in his "Manhood of Humanity".

I too have a chip on my shoulder, and as one of the mad ogres of modern times, a technologist, a blind self-abasing servant of the machine, I reject intensive definitions and choose to present my own extensive one of man, an outgrowth of that of Korzybski, and I choose the label *homo aedificans*, "man the builder" to hang onto my definition. Intensive definitions should be left to metaphysicians, so it is up to me to make it credible that my definition is extensive. The instructions for verification of the definition are as follows:

"Observe the surface of this planet for at least one revolution round its primary in sufficient detail to resolve features one hundred millionth of its circumference in extent. You will observe several lifeforms that produce artefacts from the material in their enviromnent. Further observation will show that in the case of all but one of these lifeforms a given lifeform produces but one type of artefact and that only within a sharply limited ecological framework. However, the residual lifeform will be observed to produce a multiplicity of artefacts and may be seen to produce the same artefact out of varying environmental material by appropriate intermediary processes. If you were to extend the period of your observations to a hundred revolutions

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round the primary you would observe that no change has occurred in the range of artefacts produced by the lifeforms except again in the case of the one lifeform previously noted. Some artefacts previously produced by this lifeform will not longer be produced, some will be made out of entirely different environmental material, and a large number of artefacts not previously produced will now be noted. If you were to improve the resolution of detail of your observations by a linear factor of one hundred you will observe a class of artefact that may be deduced to be symbolisations, abstractions, of other artefacts, of events, or of actions of the lifeform. The lifeform you have particularised by your observations is called *man.*"

This definition of man says nothing of heart or soul, of art or intellect. It is ignoble, you may say. Perhaps. But it is verifiable, it is devoid of private assumptions and comprises only directives for the performance of actions that will lead to the recognition of the species under discussion. It identifies man as the sole maker of gadgets and widgets on this planet, that is, by his technologies.

A few years ago such a definition might even have been challenged as totally inadequate by archeologists and hominid palaeontologists, who had developed an evolutionary sequence largely derived from the cranial capacity of the pre-sapiens remains found. Recent years have seen the excavation of many more archeological sites in many more parts of the planet and it has become clear cranial capacity is a secondary development. The record now shows that tool-using and tool-making goes much further back in our ancestry than had previously been supposed and, which is more important, that each stage of cranial development is *preceded* by a change in the skeletal structure of the limbs giving greater manipulative skill, and the archeological record confirms that our ancestors immediately used the new skill to make more refined tools, before their cranial capacity had increased. The gadget is the father of wisdom.

A persistent thread in anarchist and libertarian writing, as elsewhere, is the denigration of modern technology and the expression of a thirst for the simple life, the natural life. It is presupposed that if man can slough off his concern for things he will behave more nobly towards his fellow man. The proponents of this sort of argument point to "the simple happiness" of various primitive societies. There are several answers to this view. Firstly, the range of expectations is much narrower in such societies and therefore so are the expressions of discontent. Secondly, it is no great achievement for a society the majority of whose members are malarial or ridden by deficiency diseases to be placid, and content with the simple fact of being alive. If you expect your children to die in the first year of life and if you have no great life expectancy then there is little inducement to be ambitious or to carve out an empire. Thirdly, the technological accomplishments of some of these societies put our own engineers to shame. Within the strict limitations of their arctic environment the Eskimo have exploited its resources and invented gadgets that have no equal. They

have no word for war because they are too busy making and using gadgets to keep alive.

In conjunction with the arguments about the simplicity of life is that about the natural life. Usually this is assumed to be pastoral, horticultural, or agricultural. I fail to see what is so natural about any of these. They are as artificial as the construction of nuclear reactors. The only natural habits for man would be to wander unclothed and without constructed shelter, without fire, gathering herbs and fruits to eat raw and catching small animals with his bare hands to gnaw raw, and most certainly without any language to use to communicate with his fellows. All else are constructs of a social technology of very great complexity. No natural lifer would admit conditions as primitive as those I have just described as his ideal. But none can adduce reasons why his utopia should be permitted to indulge in the degree of artificiality he feels to be desirable whilst forbidding other artificialities.

I must ,of course, put up my own version of what is "Natural" for man. It is to manipulate his environment to facilitate, directly or indirectly, the survival of himself and of his species, the survival value of his actions depending on his current apprehension of reality. A corollary of this view is that stasis is inconceivable for humanity. And a survey of human history will quickly confirm that change is not something facing us now, from which we can retreat into some golden era of the past, but that it is a part of all we know of ourselves, a normal condition of the race, and that it has always been with us.

The agrarian utopia can only succeed in an environment so devoid of natural resources that innovation and invention are impossible, where the struggle to survive by present means is so intense as to preclude the spare time and energy requisite to the devising of other means. Under more favourable circumstances the utopia of this type is self-destroying if stocked with healthy human stock, it will invent and innovate its way from subsistence to technological exuberance. Invention and innovation will not be confined to the arts or philosophy or the love of one's fellow man, there is no evidence that these can be independent of material activity, and indeed there is overwhelming evidence that the humanitarian must be preceded by the technician, to prepare an environment in which the race can afford the graces of life.

And if man succeeds in creating an environment in which he can exist without inventive effort then he will be dead. When curiosity and questing cease the end has come. Why should this curiosity be exercised upon the material world and not upon the finer delights of metaphysics, charity, and love? Because we live in this material world, it is our world, it is the raw material out of which we can fashion lives of our own choosing, if we have the will and the comprehension to do so. Remember the men who are regarded as the two greatest artists ever, da Vinci and Michelangelo. First and foremost they were manipulators of materials, technicians, engineers. First they had to invent the paints and other materials of their art, to devise the engineering rules for their sculpture and architecture. They commanded the material world, and

comprehended it as best as they were able. Their art was based on the foremost advances of the technology of their day. Today the castrate artist hides his incomprehension of the world he inhabits behind flabby talk of art and is impotent in the face of reality, the human race has outgrown him, he is retarded in his development. In a frenzy of imagined superiority he has abdicated his right to fashion the materials of our daily lives, and then has the childish petulance to blame others for his own futility.

The relevance of this view of the world to the anarchist discussion is at least threefold. In the first place, it is a view held, usually inarticulately and even unconsciously, by very many people in positions of effective control in our culture. The task of the anarchist propagandist does not begin with attempts to persuade these people of the validity of the anarchist standpoint. The difficulty is far more fundamental, it is incumbent upon the anarchist to discover a common basis of discourse from which he can address the technologist. To the anarchist it may be a self-evident truth that "man is born free, and everywhere he is in chains". It is not. It is a metaphysical, not practical, statement. It requires the exhibition of examples of the states of freedom and bondage.

Man is born free. But unless he is subjected to the most rigorous social discipline in his youth not even an anarchist is likely to claim his as comrade. For infant man must learn a language, and learn it correctly. By correctly I mean that he must learn to frame his own communication in such a way that he conveys whatever he wants to convey to others, and at the same time learns to pay attention to the communications of others so as to apprehend their meaning. By the time he has achieved fluency of expression a man's "natural freedom" has been severely circumscribed by society. It is a very simple, practical, affair. If you wish to be a member of society you must obey the rules, if you ignore the rules you remain outside society for you are bereft of the means of communication. You can babble as much as you like about freedom, but your babbling will be couched in terms that obey the strict social rules if you wish your effusions to have any effect.

So, maybe, man is born free. But unless he looses his freedom he ceases to be man. It is even doubtful that abstract thought is possible for us without the use of linguistic symbolism. The hermit is indebted to generations of social effort for the language in which he postulates his withdrawal. Without the cultural apparatus that your ancestors and your fellows have provided by laborious toil you, individual man, are less than nothing. You have not even the instincts that enable most animals to live, you depend for your survival upon the accumulated effort of the race.

Comrades, you see your problem!

The second problem for the anarchist in an expanding society is that of education. In an earlier issue of this journal it was asserted that an anarchist education must not compel the child to learn subjects that it does not spontaneously wish to follow. I hope that the writers were not prepared to make a few points of safety in a technical

environment an elective subject. For instance, do not touch live electric mains. Now if these points are neglected we have, of course, solved the problem of overpopulation brilliantly. If we do make personal and public safety compulsory, but make the background subjects elective, we have made witchcraft the basis of our society. For without a thorough comprehension of the "laws of nature", of science, such safety precautions are just witchcraft, or the edicts of a vengeful god. You will not get a free and open society if the basis of the elementary rules of survival is not understood by those upon whom they are enjoined. Further, unless a citizen is somehow made aware of the existence of fields of human knowledge and experience and ignorance then he has no chance to be interested in them. You cannot look for an answer before you know that there is a question. A fully elective education would be a disaster for the child.

The third problem is that of authority. This is allied to the previous one. In a technical society decisions must be made and directives must be issued if the society is to exist at all. For instance, if automobiles are desired then a rule of the road must be established *and rigorously enforced*. We cannot choose to drive on the left or the right at will, whatever our political or philosophic persuasion the brute facts of mobile tons of machinery impose their own discipline. I said that directives must be issued. They must also be enforced. Whatever your views on the common ownership of land you cannot be permitted to wander at will on an airfield, if necessary you must be shot dead before you can endanger an airliner landing with a hundred passengers aboard.

The usual anarchist reply to the above problem is that it would not, of course, exist in a free society where all men would behave reasonably. But reason and goodwill are not enough. Knowledge and understanding must be there also, and if people are free to learn or ignore the simple facts of their daily life then you must guard against the blunders occasioned by their ignorance.

Of course we can go back to the argument about the abolition of technology. By all means yearn for your little womb of pristine safety and simplicity. Do not expect the rest of us to follow you there, or to honour you for fleeing thither. And if we find that we could put your corner of paradise to more congenial use we shall probably wrest it from you without pity or remorse. Violence is the last resort of the incompetent, and oft we are incompetent. But the fact that we are incompetent does not make us scurry off to a dark corner to brood in fear, we shall try to develop competence, it will cost blood, toil, tears, and sweat, both ours and yours. We know a little of whence we come, we know almost nothing of where we are going, but we shall go on, impelled by the monkey instinct, by the hands of the artificer, by the thoughts of the scientist, by the dreams of the men who sought the summits of mountains and the deeps of the sea, the poles of the planet and the reaches of space. Because we are men.

We build and we also destroy. Often we destroy through ignor-

ance. Our technology is yet poorly used, we damage ourselves with it. It has always been thus, the Roman farmers impoverished the soil of Italy with their sheep two thousand years ago, we must always be aware that every act may be a mistake. But the symbols of our common humanity are our artefacts, the tools by which we enrich and enlarge our experience and comprehension of the universe we inhabit. You may seek to change us, but to reach us you will have to undergo the discipline of language, perhaps the most complex of our artefacts, and the search to convey your meaning to us will lead you first to examine our meaning, and to be tainted by it.

When Shelley pictured science as a modern Prometheus who would wake the world to a wonderful dream of Godwin, he was alas too simple. But it is as pointless to read what has happened since as a nightmare. Dream or nightmare, we have to live our experience as it is, and we have to live it awake. We live in a world which is penetrated through and through by science, and which is both whole and real. We cannot turn it into a game simply by taking sides.

And this make-believe game might cost us what we value most: the human content of our lives. The scholar who disdains science may speak in fun, but his fun is not quite a laughing matter. To think of science as a set of special tricks, to see the scientist as the manipulator of outstanding skills—this is the root of the poison mandrake which flourishes rank in the comic strips. There is no more threatening and no more degrading doctrine than the fancy that somehow we may shelve the responsibility for making the decisions of our society by passing it to a few scientists armed with a special magic. This is another dream, the dream of H. G. Wells, in which the tall elegant engineers rule, with perfect benevolence, a humanity which has no business except to be happy. To H. G. Wells this was a dream of heaven—a modern version of the idle, harp-resounding heaven of other childhood pieties. But it is in fact the picture of a slave society, and should make us shiver whenever we hear a man of sensibility dismiss science as someone else's concern. The world today is made, it is powered by science; and for any man to abdicate an interest in science is to walk with open eyes towards slavery.

—J. BRONOWSKI: *Science and Human Values.*

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2. The terrible flaw

MAURICE GOLDMAN

AT ONE TIME MAN BELIEVED IN MAGIC, then he believed in religion, now he believes in science. Science has become a mood with which we view the world. Progress and rationality are partners with science in the unfolding of scientific knowledge and they are the bearers of the red carpet of civilisation laid down in science's path and wake. But the progress, rational, science complex is now becoming suspect and nothing has done more to totter the great god Science on its pedestal than the creation of its own frankenstein—the atomic bomb. However on the level of scholarship, psychoanalysis has attacked the morbidity of the modern science complex because of its renunciation of human nature, and because of its aggressive dominating attitude to the rest of nature.

Modern science, in its self-defeating, aggression on nature has posed an antithesis between the senses and the intellect. Scientists before the modern era, when they were still natural philosophers, used the senses in their arts of discovery and observation. Now the word "scientific" means knowledge-making and the aim is possession and mastery over objects. It is an obvious consequence of science's own view of itself—that it is coolly rational, calculating and secular. Scientific thinking is looked upon as being impersonal, objective, abstract and quantitative. The parallel may be drawn between the early natural philosopher's investigation of nature and the explorers of new worlds who embarked upon their voyages more through adventure than profit; but the modern scientist parallels the soldier and exploiter who reshaped the discoveries in their own image, to fill their own pockets and enhance the power and prestige of their sovereigns.

Modern science is at present engaged on what approximates to a totalitarian war on nature. It pursues its objective aim with the brutality of an individual beset by an anal-sadistic complex, who by rationalisation persuades himself that his actions are the inevitable outcome of the historical process, necessary, and that he is sternly committed to the god Science itself. One has not got to go far to find extreme examples of this attack on nature—the nuclear tests, mixamytosis, mass vivisection for purposes of dubious validity, smog, harmfully overstuffing the earth and animals with chemicals to provide unwanted surpluses.

Even where science has allied itself (apart from the obvious death

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forces of the vast war technology) to the whole-hearted endorsement of the life forces, medical knowledge and food production, its lack of an erotic sense of reality and its commitment to the reality principle and not the pleasure principle is evident. In medical knowledge, science has shown itself to be diffident about prevention and has thrown its weight on *cure*. Once more it has scorned the senses of the body and the idea of full enjoyment of life and its policy seems more to be to prevent the loss of working days and man-hours. There is no parallel western movement in medicine as in the east and near east (in the historical light) on breathing, diet, sex knowledge, gymnastics.

Pursuing this idea, even *cure* has been left in the hands of vulgar commercialism. More and more drugs, which doctors and patients and thoughtlessly used on their bodies are becoming suspect. Today, even phenacetin which has always been a basic medicine, has been shown to cause cirrhosis of the liver. And has not the lunge which science has taken in the direction of birth control pills and at the conquest of death been wild swipes in the wrong direction because of a lack of any erotic sense. The first endorses man's tyrannical "genital complex", the second his neuroic absorption with the inevitable when he should be living the full life of his senses.

It is not the writer's intention to deny that science has made very positive gains in the direction of the conservation of life. What is called into question is not this quantitative aspect of existing for a lengthy span of years, but the qualitative attitude of modern science towards living. Man, by his very nature of Apollonian providence and his anxiety for security has always been *the* surplus producing animal. By means of trial and error in thought and action some communities now produce more than they can eat. Food has become mass produced. (The facts of adulteration, deterioration of quality, food poisons such as insecticides however are proven facts. It is not the intention to take up this debate now. Although this one thing is evident, food like manufactures seem to be produced more for exchange value than for use value. Quality suffers).

Positive modern science prides itself that it makes no value judgments, that it is thoroughly objective. The modern scientist will tell a farmer how to increase his crops tenfold, but he will not raise a murmur when the government pays the farmer *not to grow* . . . even when others are starving. The scientist holds down a job you might say, a government job at that. Leave value judgments to the politicians! That brings us on to *specialisation* which we will deal with in the next paragraph. But now value judgments! There is nothing the positive scientist fears more than value judgments and that is one of the main reasons why the orthodox economist loathes the welfare economist—he wants to be a positive scientist where as welfare economist can't make those pretensions . . . welfare might bring his science into disrepute. But the modern positive scientist makes value judgments all the time. He tends to forget that science deals with phenomena that appear to the senses we possess. His instruments, however delicate,

are but methods of extending sense experience and his selection of facts consist of value judgments, as much as the artist's selection of sensory experience. But our criticism goes deeper than the hypocirsy of the scientist. It extends to the morbidity of his unconscious schemata. to quote Norman O. Brown on the historian Gaston Bachelard's conclusions on science:

> " . . . It is the essence of the scientific spirit to be mercilessly ascetic, to eliminate human enjoyment from our relation to nature, to eliminate the human senses, and finally to eliminate the human brain."

Now the entire use of the brain is called into question. It becomes an obstacle because it co-ordinates human movements and appetites. And quoting Ferenzi: "Pure intelligence is thus the product of dying, or at least of becoming mentally insensitive, and is therefore in principle madness." Brown calls for a science based on an erotic sense of reality and for the social project of resurrecting the body as a whole.

A terrible flaw in the organisation of science and in its resulting world outlook is the deadening grip of specialisation. Paradoxically, science has bred a race of ignoramuses. The vastly increased specialisation means that men and women must spend hypnotised years in one tiny branch of science so that they cannot see the wood of human industry for the trees of specialised endeavour. And if in the archaic economy, gift and countergift organised the division of labour and incidentally enabled man to unburden himself of some guilt, in modern times, it is science itself that both organises and is caught in the grip of the division of labour. Progressively its view of life diminishes. The instrument maker is a specialised instrument maker; his life revolves, say, upon the measurement of thrust of a missile. When he thinks of larger things he might think of the molecular structure of the heat resistant shield or even of a man who presses the button, or even of air/navy rivalry. It is fairly safe to bet he won't go into the philosophy of missile throwing, or dabble with tthe state of affairs on the other side of the world.

Science today stands at the pinnacle of civilised culture. The priest has been cowed by the scientist and the politician tries to capture his services (and timorously to keep him in the chains of national security). Science has brought certain of man's omnipotence of thoughts to near reality. But man remains unhappy and is driven to even greater restless striving. Among our universally neurotic mankind, power and materialism are at a premium. The lust for power (through money which gives command over the labour of others, prestige, fame, etc.) and the materialism of the world (alienation from the self and the increasing concentration on things) are the very fields for modern science. The weapon is now more powerful than the army or the battleship which the politician commands, it has long crushed the spiritual power which the priest commands. The politician and the scientist are the modern partners in power, not the politician and the priest. The politician has dropped the priest very gingerly on to

his spiritual bed and wonders uneasily whether he in turn will not be top-hatted and superannuated by the scientist who possesses that magical thing—the know-how.

Science with its know-how has lost any trace of humility. It might, to the benefit of humanity remember the gentle rebuke that Freud gave (and Freud if anybody was imbued with the scientific spirit) in *Civilisation and Its Discontents*:

> " . . . but a critical, pessimistic voice makes itself heard, saying that most of these advantages follow the model of those 'cheap pleasures' in the anecdote. One gets this enjoyment by sticking one's bare leg outside the bedclothes on a cold winter's night and then drawing it in again. If there were no railway to make light of distances my child would never have left home and I should not need the telephone to hear his voice. If there were no vessels crossing the ocean my friend would never have embarked on his voyage and I should not need the telegraph to relieve my anxiety about him. What is the use of reducing the mortality of children when it is precisely this reduction which imposes the greatest moderation on us in begetting them, so that taken all round we do not rear more children than in the days before the reign of hygiene, while at the same time we have created difficult conditions for sexual life in marriage and probably counteracted the beneficial effects of natural selection."

Science gives some benefits with the one hand and snatches them away with the other. By means of pest control and fertilisation it gives us better crops (though there is no knowing what thalidomide seeds it might be sowing in the earth and our bodies) . . . but it also poisons our crops and ourselves with radiation dust. It has given us the motor car but also the death and injury rate on the roads, higher than any endemic disease of the past. I do not quote these things to belittle science's achievements but simply to put them in perspective.

But the weightiest indictment of science come from the general theory of psychoanalysis. Baudelaire has written that real progress is in the wiping out of man's original sin—the wiping out of his shame and his guilt feeling which he imbibed with infancy. Real progress is also the wiping out of his neurosis and his constipation with the past, to reclaim for the consciousness the repressed unconscious mind, to demand happiness instead of power, to overcome self ignorance and to partake in the resurrection of the body and the full enjoyment of life, to be able to accept both life and death of the body. Real progress lies in satisfying our organic demands, in lessening hate and intolerance, in achieving a greater humanity, tolerance and awareness of love. Modern science must recognise as psychoanalysis has recognised that all culture is sublimation of our real desires, that rationality is drawn off the path of objectivity by instincts as much as a "free" swinging magnetic needle is drawn towards the magnetic pole.

It is only when science recognises that it as much as any other field of human endeavour involves value judgments that it will learn humility, tolerance and perhaps base itself on a erotic sense of reality rather than a multiplication of gadgets, mechanisms and cool, mechanical rational "brains".

The development and significance of cybernetics

W. GREY WALTER

IN AMERICAN ACADEMIC CIRCLES THE GREEK LETTERS PHI BETA KAPPA have a particular meaning; they are the initials of a society of distinguished scholars, selected for their talent and attainment in the Arts or Sciences. These letters stand for a maxim which is generally supposed to mean: "Philosophy is the steersman of Life".

During the last ten years the essentially ambiguous statement (and ambiguity is a common feature of classical maxims) might well be considered to have been received by inversion; for cybernetics, the art and science of control, has been claimed to provide a new and powerful philosophy in which the problems of physical, living and artificial systems may be seen as an intelligible whole. To what extent is this claim justified and from what has this school of thought developed?

Historically, the term cybernetics was first used in a general sense by Ampère in his classification of human knowledge as "la cybernétique: the science of government". In etymology the term is, of course, cognate with government, gubernator being the Latinised form of the Greek for "steersman". The re-introduction of the word into English by Norbert Wiener as the title of his book, published first in France and later in America, marked the beginning of the new epoch in which the problems of control and communication were explicitly defined as being common to animals, machines and societies, whether natural or artificial, living or inanimate.

The origin of Wiener's interest in this development was the invention of electronic aids to computation toward the end of the war, combined with his personal contact with neurophysiologists who were investigating the mechanisms of nervous conduction and the control of muscular action. Wiener was at once impressed by the similarities of the problems posed by military devices for automatic missile control and those encountered in the reflex activity of the body. As a mathematician and scientist of international repute and wide culture Wiener was so powerfully repelled by the military applications of his skill as he was attracted by its beneficient uses in human biology. In his

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second book "The Human Use of Human Beings" he develops his humanist, liberal ideas in application to social as well as physiological problems, in the hope that it may not be too late for the human species to find in machines the willing slaves essential for prosperous and cultivated leisure. Writing at a time when the ignominious annihilation of a hundred million innocent bystanders is a calculated risk, as Wiener admits, this is a very faint hope indeed.

Associated with Wiener in the first years of the cybernetic epoch were a number of American mathematicians, physicists, engineers, biologists, psychologists and medical men, and this inter-disciplinery texture is ,of course, the most striking feature of cybernetic groups. Within a short while of the publication of "Cybernetics" the Josiah Macy Jnr. Foundation organised the first of ten conferences on this subject, and the proceedings of the last five of these form an indispensable treatise on the widest range of subjects, including computer technology, semantics, brain physiology, psychiatry, artificial organisms and genetics. The factors common to all these topics may be found in the sub-title of the Macy publications: "Circular, Causal and Feed-back Mechanisms in Biological and Social Systems". The phrase that has caught the ear of many listeners to such discourses is "feed-back mechanisms", partly because the notion of feed-back has been invoked to account for a wide variety of natural phenomena and embodied in many artificial devices to replace or amplify human capacity.

To physiologists, feed-back is familiar under the name of reflex action, and the novelty of the concept in engineering is an indication of the youth and navieté of that discipline. No free living organism could survive for more than a few minutes without feed-back or reflexive action and this truth was embodied in the famous dictum of Claude Bernard *"La fixité du milieu intérieur est la condition de la vie libre"*. Freedom of action depends on internal stability, and this latter can be attained and maintained only by the operation of forces within the organism that detect tendencies to change in the environment and neutralise or diminish their influence on the internal state. The diagram illustrating this process of reflexive control or homeostasis could represent the mechanism of temperature control in a man or the position of a paramoecium in a drop of water, or the ignition timing in a motor-car or the volume control in a radio—or the water level in a domestic water closet. The first artificial reflexive system to be used in quantity was the rotating-weight speed-governor designed by James Watt and mathematically analysed by J. Clerk Maxwell in 1868. The verbal description of such devices emphasises their peculiar interest; in a steam engine with a governor the speed of the engine is controlled—by the speed, in a water closet the water level is controlled—by the water level, and so forth. What then controls what, and for what purpose?

The concept of purpose emerges inevitably at an early stage in such reflections and one of the interesting consequences of cybernetic thinking is that teleology, for so long excluded from biological philosophy, re-appears in a more reputable guise as a specification of dynamic

stability. When scientific biology emerged from Pre-Darwinian natural history it became unfashionable to ask openly the question "what is this organ or function for?" Most biologists, being at heart quite normal human beings, still thought privately in terms of purpose and causality, but wrote and spoke publicly in guarded reference to functions and associations. The horrifying dullness of traditional scholastic biology is largely due to this superstitious fear of teleology which is in direct conflict with everyday life and makes the study of living processes as dreary as the conjugation of verbs in a dead language. At least in the physical sciences the distinction between the laws of nature and human purpose is useful and explicit.

The application of cybernetic principles to biology permits the classification of questions in the sense that in some cases it is legitimate to consider the purpose of a mechanism or a system when it can be shown to have a reflexive component. This criterion implies knowledge of what variables are limited, regulated or controlled and what would be the effect of their release from such control. Thus, in the case of the humble water closet, failure of the reflexive mechanism would leave the tank either empty or overflowing; the water level would seem to be the controlled variable and the ball-cock to control it. But the ball-cock is also controlled by the water-level. The flow of water might be a device for regulating the level of the float; our interpretation of the system depends on *a priori* or experimental evidence about the purpose of its design. Strangely enough, the introduction of *purpose* blurs the concept of *causality*. In a simple water tank without a ball-cock arrangement we can assert quite confidently that the flow of water *causes* the tank to fill and overflow; if the tap is shut the tank will *never* fill, if it is open, however slightly, the tank *will* fill and finally overflow. In such a system, the causal relation is clear but the *purpose* is undefined; there is no statement or observation about what the tank is for, and the amount of water overflowing will ultimately be exactly equal to the amount flowing in. Obviously the tank is a store or reservoir but its purpose is obscure. Now in the case of the reflexively controlled water tank, the purpose of the ball-cock is to control the water-level, but the circular relation (water level: ball-cock position: water-level) erases the arrow of causality. This example is so mundane and familiar that the principle it illustrates may seem trivial, but the distinctions between linear and circular processes and between purpose and causality are not limited to gross mechanical devices; consideration of their implications may help to resolve many basic paradoxes of philosophy.

Even if cybernetic development is regarded as essentially a branch of engineering rather than philosophy, the appearance of common principles in practical subjects as far apart as astronautics and epilepsy suggests that at least the artificial, academic boundaries between the faculties of physical science, biology, engineering and mathematics can be transcended with advantage and without risk of major error.

The fusion of traditionally detached topics is one of the big features of cybernetic thinking. This often appears in a practical form as the

contructions of models or analogues, in which some abstract or theoretical proposition is embodied in "hardware". The advantage of this procedure is that the ambiguity of vernacular language and the obscurity of unfamiliar mathematical expressions are both avoided. In the examples already given the assertions in words that "reflexive behaviour gives an impression of purposefulness" or that "stability can be achieved by negative feedback" are all open to misunderstanding, particularly when translated into a foreign language. Verbal arguments about these propositions usually end with the familiar disclaimer—"it depends on what you mean by . . . ". But when these propositions are embodied in working models their content is unequivocal and their implications are open to test and verification. Such models may be called "crystallised hypotheses": they are pure, transparent and brittle. Purity in this sense is achieved by strict application of the principle of parsimony, associated in Britain with the name of William of Ockham to whom is attributed the maxim "entia non sunt multiplicanda praeter necessitatem". In a cybernetic model every component must have a strictly defined and visible function since all material components represent "entities" or terms in the basic theory. The transparency of such models derives in effect from their simplicity and the lack of needless embellishments and decorations; their function is to encourage the scientist to look *through them at the problem.* The third great advantage of a good model is that because of its simplicity and unambiguous design it is semantically brittle: when it fails it breaks neatly and does not bend and flow as words do. In this way the orderly and practical classification of complex phenomena can be based on pragmatic material experiment rather than on a verbal synthesis that may, and usually does, arise from a purely linguistic association.

Unfortunately, one conclusion to be drawn from this is that an article such as this one is really unsuitable as a vehicle for cybernetic ideas since it must commit just the errors that cybernetic thinking tries to avoid. Attempts have been made to overcome the deficiencies of conventional channels of communication but none has succeeded, and perhaps the most pressing task for cyberneticians is to work out a means of organising themselves in a new way so that the traditional frontiers between disciplines can be transformed into highways of intellectual commerce. The few text-books and monographs also are essentially traditional in format and presentation though they embody original and provocative ideas. For example, the works of Ashby ("Design for a Brain" and "An Introduction to Cybernetics"), George ("The Brain as a Computer"), Cherry ("On Human Communication"), and the modest but well balanced "La Cybernetique" of Guilbaud are excellent treatises but all bear traces of the specialist training of the authors and also of their natural deficiencies in the fields strange to them. The fault is not in these individuals but rather in the structure of our Western culture that still demands academic specialisation for survival. Even now it is difficult, if not impossible, for a talented young university student to study, for example, physics, mathematics, biology

and sociology for an honours degree, and until this is an accepted course cyberneticians will be essentially amateurs in all but one branch of their subject. The fact that it is still impossible to be a professional cybernetician (in the sense that one can be a professional physicist or biologist or mathematician) gives the domain an attractive character of freshness, enthusiasm—and sometimes irresponsibility. It is quite easy to speculate and conjecture about possible machines and even to sketch out a design for them, but quite often the report or rumour of such designs has grown into a legend of a real super-robot. We must remember that it is as easy for a speculative scientist's sketch of an electronic fantasy to become a reputed master-machine as it was for a mariner's fable to establish the sea-serpent. In these days of science-fiction turning to reality before our very eyes there is a real danger of the myth-makers reporting dragons where there are only electronic tortoises.

In the English language at least these rather tiresome misunderstandings have often arisen because of the fashion for using the term "model" for hypothesis or theory or scheme. In the literature of cybernetics it is worth examining every reference to a "model" carefully to see whether it refers to a real piece of machinery or merely to a schematic notion.

In many cases the absence of a working model is justified by the futility of building a costly machine to perform a function which can already be envisaged clearly in the "paper model". The basic axiom invoked—and one that is indeed fundamental to cybernetics—is that any function or effect that can be defined can be imitated. This is taken to apply even to the highest nervous functions of human beings and the power of the axiom is seen when such functions have to be defined. A typical case is that of translating machines in which the function would appear to be simply to transpose information from one code or language into another. The information in, say, an English—Russian dictionary can easily be transferred to an electronic computer and a program compiled to ensure that whenever a word in one language is presented to the computer the corresponding word in the other language is typed out. The outcome is explicit and inevitable if the term "translation" is defined in this way as a one-to-one relation of words in the two languages. But everyone knows that for many of the words in such a dictionary there are several possible meanings, so the output of the computer would consist not of one word for each presented, but several words or even phrases. Furthermore, there may be no equivalent at all for some words.

The lesson here is that language, even in its most commonplace usage, is not deterministic but probabilistic: the information conveyed in any particular message depends on the foregoing and succeeding messages as well as on what else might have been said. The introduction of such notions of statistical probability into what were previously considered essentially logical situations is another of the important theories of cybernetics. On the mathematical side cybernetic principles

are seen also in the contemporary approach sometimes described as "Finite Mathematics" in which limited concepts of sets, binary matrices and conditional probability are considered as including the special cases of conventional algebra and arithmetic.

The elegance of binary arithmetic as a practical implement from the obscurity of Boolean algebra is another significant example of bio-mathematical convergence. One of the great achievements of neuro-physiologists in the early part of the 20th Century was the establishment of the All-or-none Law for excitable tissues such as the heart, muscle fibres and nerve fibres. Careful experiment showed that a single cell in heart, muscle or nerve could respond to a stimulus in only one way, by a unit impulse discharge of standard size, duration and velocity of propagation. A stronger stimulus might elicit a larger number of unit impulses but they would always be the same size.

If the transmission of nerve impulses is considered as a language then it is a language with only one word—"yes". This poverty of vocabulary has several important implications; the system must be non-linear, or in physiological terms, has a threshhold, a level of stimulation below which no effect is produced and above which the unit impulse appears. The mathematical representation of this relation would be a "step-function" in which there is an abrupt change in an ordinate value at some point along the abscissa. Another implication is that for the impulses in any given nerve channel to convey any specific information, the source of the stimulus must have a predetermined relation to the destination of the nerve channel. Physiologically, the nerve from, say the eye to the brain, will indicate *light* however and by whatever it is stimulated. The concepts of all-or-none response threshold and local sign are fundamental to neurophysiology and were accepted many years before the corresponding notions emerged in the cybernetic consideration of communication and computation.

Another factor common to biological and cybernetic systems is large numbers of elements. In the nervous system there are the nerve cells with their processes the nerve fibres, while in an artificial device they are most likely to be a non-linear component such as a pair of valves or transistors to provide the appropriate unit impulse or binary digit. The provision of very large numbers of elements is again familiar in biology though novel in artificial systems. The cells in the body are counted in milliards and in the human brain alone there are about ten thousand million nerve cells, but this number, vast though it is, is not the significant one in relation to brain function; it is the enormously greater number of ways in which these elements can interact with one another that indicates the scale of cerebral capacity. In artificial machines the number of elements does not yet approach that of the brain cells, but their speed of operation can be very much greater. The unit impulse of a brain cell or neuron lasts about one millisecond and the maximum discharge rate is rarely more than a few hundreds per second. In modern computers the pulses are more than a thousand times shorter and their frequencies of discharge are measured in millions

per second. The rate of working of artificial systems can therefore be enormously greater than in living ones and it is commonplace for a calculation that would take a human mathematical prodigy several minutes, to be completed in one thousandth of a second by an electronic computer.

"Spontaneous" activity is generally considered as undesirable in a machine, but this is the principal feature of living animals from the unicellular protozoa to man, and no artificial system can be considered lifelike unless it displays some tendency to explore its surroundings. The illustration of this property was one of the main functions of the first "artificial animal" *Machina Speculatrix* which contained only two neurons, two sense organs and two effectors. The origin of this creature can best be described in terms of my own personal difficulty in envisaging the mechanics of reflexive behaviour. As a physiologist my professional working hypothesis is that all behaviour (including the highest human functions) can be described in terms of physiological mechanism. In trying to establish the principles on which such descriptions could be based I found great difficulty in deciding how complex the *basic* mechanism must be. Obviously a single cell with only one function is trivial and inert unless stimulated. When two are included in the system so that they can interact freely however the whole situation is transformed at once. Where the single element system has only two modes of existence, on and off, the two element system has seven.

Now, in order to couple this system to its surroundings some sensory modalities were necessary and the two that convey the simplest direct information are light and touch. But even when provided with a photo electric "eye" and a sensitive "skin" the creature was passive unless stimulated and was no more lifelike than a telephone or a pithed frog. In order to give it "life" I provided it with two effectors, a motor to drive it across the ground and another to provide a rotary scanning motion for the eye and the driving wheel. With these additions the behaviour of the model at once began to resemble that of a single protozoan; it explored all the accessible space, moving toward moderate lights and avoiding bright ones, avoiding or circumventing obstacles. Several other features emerged also (and this is one of the striking results of such essays in the imitation of life). If I had thought more clearly I might have foreseen these effects but I did not, and the fact that my thinking needed the stimulus and demonstration of the real model indicates the limitations of the experimental mind, the practical value of constant interaction between thinking and observing.

The first surprising effect of providing the model with a scanning eye was that, when provided with two exactly equal and equidistant light stimuli, it did not hesitate or crawl half-way between them but always went first to one and then toward the other if the first was too bright and close quarters. This was obviously a free choice between two equal alternatives, the evidence of free-will required by scholastic philosophers.

The explanation of this exhibition of what seems to some people

a supernatural capacity, is simple and explicit: the rotary scansion converts spatial patterns into temporal sequences and on the scale of time there can be no symmetry. Simple though the explanation may be, the philosophic inferences are worth pondering—they suggest that the appearance of free-will is related to transformation of space to time-dimensions, and that the difficulties that seemed to impress the scholastic philosophers arose from their preoccupation with geometric analogy and logical propositions.

Another behaviour mode that surprised me was related to the inclusion in the scannng circulit of an electric lamp to indicate when the scanner was switched off. The system is guided to a light by the disconnection or inhibition of the scanning motor when an adequate light enters the photo cell; sometimes the scanner would jam mechanically and it was hard to distinguish this trivial mechanical disorder from a relevant response. The pilot lamp was added to provide a sort of clinical sign to aid diagnosis or fault- finding. One evening the model wandered out into the hall of my house where there happened to be a mirror leaning against the wall. We heard a peculiar high squeaking sound that the model had never made before, and thinking that it must be seriously unwell we rushed out to help it. We found it dancing and squealing in front of the mirror; it had responded to its own pilot-light but in doing so had turned the light out, thus abolishing the stimulus so the light came on again and so on. The *positive* feedback or reflex through the environment generated a unique oscillatory state of self-recognition. If I had had no prior knowledge of the machine's structure and function and had assumed that it was alive I should have attributed to it the power to identify a special class with one member—itself.

Similar but much more complicated effects are seen with a population of several such creatures. Each can "see" the others' lights, but in responding to them extinguishes its own, so that yet another semi-stable state appears in which aggregates of individuals form and dissolve in intricate patterns of attraction, indifference and—when two touch—repulsion. If the boundaries of the working space for this co-operative population are constricted, another state is produced in which contacts between individuals and with the barriers become so frequent that a "population pressure" can be measured. This supervenes quite suddenly and at the same time the responses to light (which are suppressed by the touch stimuli) disappear. The population as a whole is then inaccessible and aggressive, while in the state of free aggregation with less constrictive boundaries individuals could respond independently to a common stimulus; the common goal transforms a co-operative aggregation into a competitive congregation.

These complex patterns of behaviour are recounted here to illustrate the value of precise definition and material imitation. If, for example, free-will is thought to be something more than the process embodied in *M. speculatrix* then it must be defined in terms other than the ability to choose between equal alternatives. If self-identification

is more than reflexive action through the environment then its definition must include more than *cogito, ergo sum.*

The relative modesty of cybernetic achievement (the early claims and promises were certainly over-dramatised) has produced various splinter-groups, some tending toward a more philosophical or at least theoretical position, others concerned with strictly practical application. Among the latter, one of the intriguing titles is "Bionics", a group in which the precedence and possible superiority of living systems is accepted, with the aim of using ideas gained from the study of real living processes to construct artificial systems with equivalent but superior performance. Thus, a man can easily learn to recognise the appropriate patterns even when they are partly obscured, must be quite complex and carefully adjusted. If we knew more about how we learn to recognise and complete patterns we could make pattern-recognising machines more easily and these could operate in situations (such as cosmic exploration) where men would be uncomfortable or more concerned with other problems.

A brief analysis of one cybernetic approach to problems of learning recognition and decision has several interesting corollaries. One is that, even in the metal, such a system provides ample scope for diversity of temperament, disposition, character and personality. In material practice even very simple machines of this type differ very much from one another, even if they are designed to a close specification, and furthermore these differences tend to be cumulatively amplified by experience. In mass-produced passive machines, such as automobiles, individual differences are treated as faults, and are usually minimised by statistical quality control. Even at this level, however, individual characters do appear and particularly when they involve a reflexive sub-system, also tend to increase with wear, which is the equivalent of experience in a passive machine.

In the models already referred to, learning is considered as a statistical rather than a logical process. Logical reasoning, the ability to solve formal problems by deduction, is considered as a special case in which the level of confidence in the data and rules is extremely high. The ability to perform deductive reasoning is thus merely the net result of many interacting statistical processes which cannot be identified individually without some prior knowledge about the mechanism itself. in the case of an assembly of systems such as CORA, acquaintance with the basic principles of exploration, selection, storage and comparison would suggest experiments to measure the characters of performance at each stage. Considering CORA as a "crystallised hypothesis" of living learning the same procedure could be applied to the study of learning in human beings in the hope of recognising the basic and essential features rather than their statistical sum.

Studies of this nature are now in progress in several centres of research. One of the important inferences from the simple models of learning is that in the far more complex living systems information from the various receptors (eyes, ears, skin and so forth) must be diffusely

projected to wide regions of the brain as a part of the preliminary selective procedure. The extent of diffuse projection in the human brain is really astonishing; nearly all parts of the frontal lobes are involved in nearly all sensory integration, and with very short delays. The non-specific responses in these mysterious and typically human brain regions are often larger and always more widespread than those in the specific receiving areas for the particular sense organs. They also have another very interesting and important property which the specific responses do not show at all, and this is perhaps one of the most fundamental attributes of intelligent machinery, whether in the flesh or in the metal—*habituation.*

If a stimulus is applied monotonously and without variation in background, the diffuse responses in non-specific brain areas diminish progressvely in size until after perhaps fifty repetitions they are invisible aganst the background of spontaneous intrinsic activity, even with methods of analysis that permit detection of signals much smaller than the background "noise". This process of habituation is highly contingent however; a small change in the character or rhythm of the stimulus or in its relation to the background activity will immediately restore the response. Interestingly enough the change needed to re-establish significance may be a *diminution* in intensity; a series of loud auditory stimuli may result in complete habituation after a few minutes but if the same stimulus is given at a very *low* intensity the response may reappear at a high level. The same effect is seen with any novelty in the rhythm or tempo and the conclusion is that, as predicted from the cybernetic model, the brain response to a single event is a measure of its novelty or innovation rather than of its physical intensity or amplitude.

This observation probably accounts for the apparently (and literally) paradoxical effect described as "sub-liminal perception". This phenomenon has attracted great interest as a means of "thought control" in advertising or other propaganda; it involves the presentation of a selected stimulus (such as an exhortation to buy a particular product or vote for a certain candidate) at a level of intensity, or for a brief period, below the threshold of "conscious recognition". Stimuli at "sub-threshold" levels have in fact been found to influence the statistical behaviour of normal human beings without their being aware of the nature or moment of the stimulus. These effects are so subtle and could be so sinister that attempts at sub-liminal influence have been banned in many countries by advertising associations. The paradox of influence by subthreshold stimuli is resolved by consideration of threshold in terms not of intensity or duration but of unexpectedness or innovation. The mechanisms responsible for distributing signals to the non-specific brain regions constantly compute the information-content of the signals and suppress those that are redundant while novel or surprising signals, however small, are transmitted with amplified intensity.

The effects of information selection are even more involved when the signals are part of a complex pattern of association. When the

response to a given signal has vanished with habituation it may be restored, not only by a change in the original signal itself but also by association of this with another subsequent signal. The response to the paired signals may also habituate, but if the second signal is an "unconditional" stimulus for action (that is, to gratify an appetite, gain a reward or avoid a penalty) habituation does not occur and in fact the first, conditional response shows progressive "contingent amplification". At the same time the response to the second, "unconditional" stimulus, even if this be more intense that the conditional one, shows contingent *occlusion.*

The representation of this situation in real life is quite familiar. In driving an automobile one learns first to avoid obstacles, and this is based on the unconditional withdrawal reflex which prevents us colliding with obstacles in any situation. The next stage is to learn to avoid symbolic obstacles—to stop at the red traffic lights for example. The red light is not harmful in itself, it implies the probability of collision, reinforced by police action—it is a conditional stimulus. The action of stopping at an intersection is determined not by the traffic, but by the light. When the light changes to green however, the primary defensive action is restored and the real obstacles must be avoided. The same effect is seen in the brain; when a conditional warning stimulus which has shown contingent amplification is *withdrawn* the unconditional stimulus which has been occluded, reappears at full size at once. The brain retains the capacity for unconditional training.

A particularly interesting aspect of these observations is the evidence for a dynamic short-term memory system, and here again the resemblance of living processes to those predicted theoretically from cybernetic models is quite startling. In CORA, the third-grade memory, which stores information about significant associations, consists of an electronic oscillatory resonant circuit in which an oscillation is initiated only when the significance of associated events surpasses the arbitrary threshold of significance. This oscillation decays slowly if the association is not repeated or reinforced. Quite recently it was discovered that in records of brain responses to visual stimuli an oscillation appears following the primary response, but only when the visual stimulus has acquired significance, either by irregularity or, more often, by association with unconditional stimuli to which the subject responds with an operant action. These after-rhythms could well be the electric sign of a brain storage system linking the associated stimuli with action. The frequency and phase relations of the after-rhythms are so precise and constant that they may also be operating as a brain-clock, regulating the time-sequence of events in an orderly and effective pattern.

The relation of the conditional responses in the brain and their after-rhythms to the intrinsic brain rhythms, particularly the alpha rhythms, is still a challenging problem from which much may be learned not only about the living brain but also about the design of intelligent machines. Wiener, in his book on Non-Linear Problems and in the second edition of Cybernetics has approached this question from the

theoretical standpoint but the facts are even more confusing than he indicates. In the first place many normal people show no sign of alpha rhythms at all, so whatever function these rhythms mediate must be associated with their suppression rather than with their presence. This is not as unreasonable as it sounds for the alpha rhythms do in fact disappear in states of functional alertness and attention, and the brains of people without alpha rhythms seem to be involved perpetually in the manipulation of visual images. Secondly, the alpha rhythms are usually complex; three or four linked but independent rhythms can often be identified in different brain regions. Third, the alpha waves are not stationary—they sweep over or through the brain. In normal people the direction of sweep is usually from front to back during rest with the eyes shut, but the pattern is broken up and complicated by mental or visual activity. In patients with mental disturbances of the neurotic type the direction of sweep is often reversed to back-to-front, and this effect has been seen for a period of a few months in normal people under severe mental stress. Apart from major disturbances of this sort, the frequency and phase relations of the apha process are so constant, even in variations of age and temperature, that one is tempted to consider them as ultra-stablilised and to search for a purpose or primary function for them.

Any commonplace analogy is probably far too simple and ingenuous to do more than suggest more relevant experiments, but one mechanism that seems to have similar properties is the traffic-operated signal network on a railways or road system. Such signals are in the reflexive or feedback class since they control traffic but are also controlled by it. In the application of this system to urban road traffic the signals have an intrinsic rhythm when traffic is heavy. so that traffic flows alternately from one direction and then orthogonally. The signals along any main thoroughfare are also synchronised, with a phase-delay, so that for a period the traffic can proceed steadily at a limited pace from one end to the other without hold up. Cross traffic at intersections is held up while the "green" period lasts, but the orthogonal streets may also have phased control-signals so that when the main street "green" is over, the cross traffic also may proceed across many intersections at a certain speed. Now, when the traffic is light in one direction it is wasteful to have the same rhythm and phase of signal as when it is heavy, and the traffic-operated system ensures that a crossing is barred by a red light until a certain number of vehicles have operated the road-pad, when the crossing is opened and the phase-locked sequence is initiated for that street in its turn. When there is little or no traffic the time-sequence will operate alone, providing rhythmic waves of potential inhibition and facilitation which would be seen by a viewer as waves of green and red light sweeping rhythmically along the traffic routes. When the traffic increased again the rhythmic sweep would be interrupted, as the alpha waves in the brain cease, since each vehicle would trigger its own free-way. The effect on the traffic (in the brain the actual volleys and trains of impulses conveying information) would be to divide the

chaotic inflow into packets of vehicle alternately stationary, waiting for the green light, and then travelling at a constant speed until the end of the open route. This rather detailed description of a familiar—and sometimes exasperating—scene is presented as an example of the basic principles of traffic control which may be as important in the living brain as in a busy city.

Applying the principle of seeking purpose where reflexive relations have been identified, we may ask, what is the purpose of the system—what is actually being regulated or stabilised? In the city traffic the conditions desired are that every vehicle should have an equal chance of reaching its destination at the expected time. We must remember that every vehicle has in effect a *rendezvous,* an appointment in time and place. Applying the same interpretation to the brain as an information distributing machine, it is equally true that every signal and vehicle in the form of a train of nerve impulses, has a provenance and a destination, an appointment with some other information-packet. The systematic grouping and routing of these information-packets may well be the function of the intrinsic brain rhythms; their effect will be to limit the maximum rate of action, but avoid complete breakdown by chaotic interaction of cross-streams. In brains that exhibit no intrinsic rhythms the inference would be that all the traffic control devices are being traffic-operated and this system over-rides the time-sequence processes, while in brains with persistent alpha rhythms the intrinsic time-cycles are pre-potent and all signal-vehicles are constrained to follow this procedure. We know from our acquaintance with actual traffic systems in various cities that both the strict time-phasing and the traffic operated system can work well, and that various types of combination of both also work. We also know that above a certain traffic density any of these systems may break down and that failure-to-safety can be assured most easily by having all controls near the centre of the jam set to red while the peripheral traffic filters away. Bearing in mind that in the brain all these controls and filters are likely to be statistical rather than absolute, we may lengthen the conjecture to include the sweep-reversal seen in neurotic patients and normals under stress as a failure-to-safety device, holding up neuronic traffic but reducing the probability of collision or futile encounter.

These comparisons illustrate how observations on systems as diverse as the dark world within our skulls, the flashing lights of a busy city, the meanderings of an artificial animal and the lonely terror of a mental ward may illuminate one another to provide a general idea from which each in turn may benefit. Cybernetic claims have been derided because in many cases they seem to provide merely blinding glimpses of the obvious, and indeed the discoveries and inventions in cybernetic engineering have often been anticipated either by the evolution of living systems or by common sense. Even in the most trivial situations however, the cybernetic approach can both unify apparently remote concepts and dissolve away the aura of transcendental influence that surrounds such terms as "intelligence", "purpose", "thinking", "per-

sonality", "causality" and "free-will". We are still in the age of cybernetic amateurs, who are content to test their skill with machines that play games and imitate the simplest vital functions. The next generation of professional steersmen—who are already maturing in the great technical Institutes of many countries—will offer even more profound and revolutionary principles and contrivances to technocratic culture. One of the most significant struggles will certainly be over the cybernetics of cybernetics in society—who is to control whom and with what purpose?

Democratic society as defined in the West (that is, universal suffrage, secret ballots, two or three political parties, public debate, decision by majority in two houses, moderating influence of President or constitutional Monarch) is an excellent example of a cybernetic evolution, perhaps more steersman-like than even Ampère would have imagined. In some ways Western democracy is remarkably sophisticated. The suffrage system (one man—one vote and election by bare majority) may be defined as a binary opinion amplifier with statistical stabilisation. However strong and widely held an opinion may be, only one candidate can be elected in any constituency. On the other hand the coupling to the legislative assembly and the reflexive action of the legislation on the voters is generally slightly positive, leading to a slow control, since the President is elected every four year and one third of people, by the people, for the people" is a precise embodiment of the cybernetic axiom that in a reflexive system causality disappears as purpose emerges. One of the most delicate adjustments in Western democracy is the timing of elections to match the natural period of oscillation. The American Constitution is a perfect example of phase cntrol, since the President is elected every four years and one third of the Senate every two years. This constitutes introduction of a small component at the second harmonic frequency of the pulse repetition-rate, leading to an effect similar to rectification of an alternating pulse waveform. Politically, the effect of this is to diminish the probability of violent swing of policy from one extreme to the other; a period of relative tranquillity corresponding to two or four presidential terms will tend to be followed by a marked deflection in one direction but the opposing swing to the other side will again be diminished by the second harmonic rectification. This effect is acknowledged in practice by the traditional conflict between Executive and Legislative which is of course quite different from the system in other countries where the Prime Minister is necessarily a member of the majority party and the President or Monarch has a minimal influence in policy decisions. The ingenuity of the American Constitution reflects the cybernetic insight of its originators and its survival with only minor amendments since 1787 indicates its basic stability. If the full cybernetic implications of this unique specification for dynamic equilibrium had been realised at its inception, even the genius of Benjamin Franklin might have recoiled from the complexities of its checks and balances.

At the other extreme of political organisation, the autocratic tyranny

or dictatorship also displays cybernetic qualities of universal interest. In place of an elected assembly the dictator must rely on a spy-network to provide information about popular feeling and economic trends. As long as the political police are unobtrusive and act merely as opinion samplers the system can be stable since the autocrat can regulate his edicts by reference to popular opinion which in turn is influenced by the edicts. Serious instability in an autocratic regime arises when the poltical police actively suppress expressions of opinion by arrest and mass execution. This destroys the sources of information and ensures an explosive evolution. The principle of innovation applies here as it does in the brain; in political evolution it is the unexpected that matters and since by definition the unexpected will appear first on a small scale, minority views must be constantly sampled since among them will be found the earliest harbingers of future change. In the brain, the responses evoked by novel stimuli involve no more than one per cent. of the available nerve cells, but this minority response is a clear indication of a likely trend in behaviour. Similarly in the political system the majority is always *wrong* in the sense that it preserves the impression of the past rather than a plan for the future. The Autocrat must therefore take great care that the ears of his henchmen are tuned to dreams and whispers. This suggestion, that the majority is always wrong has important implications for electoral democratic systems also; minority views are represented in free election, but if these result in the sub-division of parties into many splinter-groups the operation of the legislative assembly becomes sluggish and inconsistent. The more effective arrangement is for the growth of a minority view to influence the bias of the opinion amplifier, that is to modify the policy of a major party.

In comparing social with cerebral organisations one important feature of the brain should be kept in mind; we find no boss in the brain, no oligarchic ganglion or glandular Big Brother. Within our heads our very lives depend on equality of opportunity, on specialisation with versatility, on free communication and just restraint, a freedom without interference. Here too local minorities can and do control their own means of production and expression in free and equal intercourse with their neighbours. If we must identify biological and political systems our own brains would seem to illustrate the capacity and limitations of an anarcho-syndicalist community.

Shock tactics and pornography

MARTIN DANIEL

IN THE EARLY SEVENTEENTH CENTURY, an aesthetic shock was accepted as a right and proper element in poetry. The "fancy" was a skilfully organized extended metaphor: preferably an astounding one. It should be revealing to consider what is probably the most astounding of Donne's fancies, the compasses simile in "A Valediction: Forbidding Mourning". At a first reading, this simile may seem merely outrageous. One might guess, perhaps, that once one had grown accustomed to this shock, these three verses would appear devoid of point. This sort of thing does happen sometimes. The most obvious example of it, is, I think, a twentieth century musical work: Ravel's *Bolero*. I recall reading somewhere an eye-witness account of the first performance. It will be remembered that the piece is a long series of repetitions of a theme upon a hypnotic rhythm, and that each repetition introduces more instruments, but that there is no key-change until the whole orchestra is engaged. At this point, the climax of the piece, there is a sudden change of key. The build-up of tension at the first performance was so great that at this point the whole audience gasped. But, observed the critic, this effect can only work once. There is a trick in the *Bolero*: the hypnotic insistence on one theme and one key builds up a tension which is only released at the final key-change. There is not enough content in the work, however, to support this final shock at repeated hearings. Or rather, this is imprecise: the nature of the shock given at first hearing or on a first reading must be different from that given when it is familiar; and there is insufficient content in the *Bolero* to support the second type of shock. Donne's compasses simile, however, remains astounding at the thirtieth reading. One might say that this capacity to continue to give the pleasure of astonishment *validates* the original shock, if it were not for the fact that even a shock given once and never again afterwards has at least that to commend it. Only one would not make a great critical fuss over this type of work. For one thing, it is not usually puzzling.

In drama, of course, shocks are a commonplace of technique. Comic relief in Shakespearian tragedy communicates a shock in that it clashes openly with the mood of the surrounding scenes. Shocks similar in type to the *Bolero* dénouement are just as frequent. An

example which comes instantly to mind is the knocking in *Macbeth* just after the murder of Duncan, when the tension builds up so that at the first bang on the castle gates the audience start. This particular example of a shock is a particularly complete one: not only in that it astounds but at the same time seems perfectly in place; not only in that it does not wear off, but can be re-experienced again and again; but also in that if one takes the scene as a whole, there is combined (in the person of the drunken porter) the technique of comic relief; so that the disturbing, the clashing and the appropriate all find their place in one brief scene.

It may be thought that it is hopelessly contradictory to justify a technique by stating that its questionability is its own justification! But just as it is ironic that "members of the public" who "cannot understand modern art" should bitterly complain that this and that in it is arbitrary or pointless, when at least a part of the artist's intention was simply to bewilder and offend "members of the public" by raising this very question[1]; so it is ironic that critics of Apollinaire, in discussing whether or not his procedures are honest or valid, do not generally perceive that a part of the *raison d'être* of those procedures is to raise this doubt in their minds. The modern artist is not merely ironic about other people, he is also ironic about himself. Yet it is fatal to take his irony about himself as the final word; for one has then fallen into the trap, his irony being at the same time an attack on those who do not understand him. These contradictory attitudes can be perhaps best comprehended by a careful consideration of such work as Picasso's "Guitar, 1926", consisting as it does of a mouldering dishrag, a piece of yellowed newspaper, some string, and a number of nails hammered through the back of the canvas. Apparently Picasso had also considered fitting the frame of the picture with broken glass to discourage people from touching it. This is amusing . But it is not *only* amusing. But that it is amusing is just as important as anything else about it. Clearly, it may be necessary to discuss the validity of modern procedures in art, but only a critic who is aware of the modern artist's attitude to validity can usefully do so.

But besides the aesthetic shock, there is the *content* shock. In discussing the first type of shock I have found it impossible to avoid the second; but this is a commonplace: the division between technique and content is always recognized to be an academic convenience. Now in so far as a content shock can be distinguished from an aesthetic shock, it is usually administered by the use of irony (which may range from Oscar Wilde's verbal wit to the disturbing and indeed shattering effects of Swift's irony in "A Modest Proposal", and which places contradictory ideas of attitudes side by side) or by quite unironic attacks on social or other conventions. Sometimes this kind of shock too can grow less effective with time. Presumably this usually happens where

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1 There are of course times when modern art is arbitrary—and this is often why. And there are times when it is not **only** arbitrary—and then there are additional reasons, but this is still one.

the contrast (between say, conventional ideas of respectability and Shavian frankness) is not built into the work by the use of irony. Thus, the mere choice of a subject such as *Mrs. Warren's Profession* was, in Shaw's early career, enough to administer a profound shock; it would no longer do so now. However, where amazing ideas (even if these are only contemporarily amazing) are combined with amazing verbal technique, as in the incidental conversation, passim, of Shaw's plays, or where the writer's irony focusses upon both contrasting attitudes, as when Swift describes the mutual incomprehension of Gulliver and the King of Brobdingnag, the pleasure of amazement can persist and even deepen. In an example like this, the irony might be thought not violent enough to amount to true shock tactics. It is a question of degree and definition. A further question of definition concerns *where* the contrasts involved occur: if for example, the shock effect is due to a contrast between two attitudes both of which are delineated by the author, this technique of delineating both must be a factor in the shock effect. No doubt it tends to make the shock persist, since the two opposing attitudes are unalterably built in to the work. But no doubt, even where the author has avoided delineating the attitude with which his own attitude (real or assumed) clashes, there are circumstances where the shock effect can be persistent. The first of these two types of content shock is more akin to the aesthetic shock, in that the author has brought an additional technique (that of built-in contrast, or irony) to bear upon it; the second might be termed "purer", since it more or less lacks this particular technique. In principle, in fact, one could imagine an entirely "pure" content shock, whose effect was due entirely to the contrast of the author's attitude (expressed) and the audience's attitude (entirely unexpressed by the author). Clearly, however, since the author was well aware of his audience's attitude from the start, this attitude has to be taken into account in judging such a work.

Now pornography is in a curious position relative to these considerations. For political attitudes can, at certain points in history, be powerful shockers. So can unconventional attitudes to religion. But these days, it is almost inconceivable that any political view expressed in print could outrage public decency as much as, say, the expression of militant atheism would; nor would the latter produce as violent a reaction as a pornographic work. The use, in fact, of unconventional political or religious material is nowadays much less effective than it used to be, and effective in a much more limited way. Pornography, too, it can be justly claimed, shocks us less than it did our grandparents. But will its effect ever fade to quite the extent the effect of left-wing propaganda has faded?

The primacy of pornography as a shocker is due to the attitude, widespread still today, that sex is private, indecent, disgusting and holy. Feelings about religion are similar, where they are held; but they are not so widely held, and where they *are* held, they are rarely so strong. But things which are holy are often also disgusting—as witness the sacred horse-meat of our Saxon ancestors, edible once a year at the feast of

the God, regarded with religious horror the other 364 days. Perhaps therefore even literature which is frank about normal sex will always retain its capacity to shock or at least disturb, since sex will certainly always be rather holy and presumably therefore always rather disgusting. Even the people of Samoa, says Margaret Mead, have dirty jokes, and sex is more socially acceptable there than perhaps anywhere else.[2]

But if frankness about normal sex (for example the frankness of *Lady Chatterley's Lover*[3] retains its effectiveness, what of abnormal sex? This should be an even more potent shocker; as such, should its employment as literary content be even more commendable? One of the difficulties about this question is of course the definition of normality. The traditional attitude amounts to the labelling of *all* sex as abnormal. Take, for example, a conventional middle-class man[4] of my own acquaintance, married, with two children, whose comment on an X film in which relatively normal sex behaviour was treated with more than ordinary frankness, was: "But Life isn't *like* that." However, it is not necessary to engage in a discussion about what is or is not "abnormal". Wide enough agreement would be obtained for the statement that "normal" sex behaviour is usually too narrowly defined. This would be agreed at least by those who have taken the trouble to study Kinsey (whose books, whatever else they lack, are at least the most authoritative yet in existence as regards the actual incidence of varying sexual practices). It would also be widely agreed that the arts should be allowed to deal with any sexual behaviour except that where violence occurs with the apparent emotional approval of the author; here there would no doubt be wide disagreement.

Now this is not, though it may appear to be so, just a terminological, legal or psychological question. For we are now touching upon the central function of the "shock" in literature. I take it that in a satisfactory reading of any work, one so to speak enters into its world, accepts for the time being its premises, lives (in a very limited sense) the experience it offers. This process is imperfect at the best of times, and one of the factors controlling it is the effectiveness with which the artist communicates. On closing the book one comes out of the artist's world, however much one has or has not accepted it during one's reading; and one inevitably compares it with one's own conception of the world.[5] Now literature *can* alter a person's outlook; even totalitarian governments agree on that. One could, I suppose, accept the artist's world, swallow it whole—sometimes, indeed, an artistic experience does seem to have the quality of revelation. Usually the revelation rapidly

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2 I regret I have been unable to verify this reference.

3 That the attitudes of **Lady Chatterley's Lover** are "normal" has been questioned (for example by John Sparrow in **Encounter**, Feb., 1962). But, however one defines "normality", nine-tenths of it is; and since the prosecution at the trial hardly noticed the other tenth, it may be reasonably assumed that even the "normality" of the book can shock profoundly.

4 This would be his own description.

5 To speak of being in and coming out of the artist's world is an oversimplification, since one is usually in the two states of mind at once; but it conveniently clarifies the situation.

rapidly fades, but sometimes it remains, to be gently amended over a long period by later experiences. More often, one does not accept it whole, but finds one's outlook modified slightly. This modification does not need to be an increased leaning towards the outlook of the artist—it may be a revulsion. In all this, the function of the shock is to suddenly or surprisingly (or both) accentuate an effect, thus increasing the pressure of the artist's vision upon his reader, or to suddenly negate it, thus increasing the pressure on the reader of his own experience.[6] These two things can be done at once, as in the scene in Macbeth already mentioned, where knocks powerfully accentuate the tension, and the comedy powerfully reduces it. Another striking case is that of the four-letter words in *Lady Chatterley's Lover*. D. H. Lawrence's intention was to "purify" them. But in fact they function as "shockers". It cannot but produce an outrageous effect to use, in a context of reverence, words whose connotation is elsewhere always contemptuous. Violent pressure is thus exercised on the reader's outlook at two crucial points: the very significance of words; and the reader's attitude, in this case to sex. Does he realize, these words ask, that attitude and actuality are different things, and that the difference is often concealed by the language we use, full as it is of emotional concepts masquerading as facts? In normal parlance, for instance, the word "cunt" means something like this: "the vagina—which is of course disgusting". To prise the emotion from the fact is a possible way in which "purification" of these words could occur. Probably Lawrence thought that *Lady Chatterley's Lover* was a first stage in the actual purification of these words for normal use; but in fact the effect cannot really outlast the closing of the book. Perhaps something that can, however, is the distinction between attitude and actuality; the way in which this has been pointed out to the reader is so "shocking" that one would think it impossible to overlook ever again. This is to be too optimistic, however; the resilience of ingrained attitudes is frequently enormous.

Perhaps one of the most important questions is how one could determine whether the effect of an artistic experience on the reader is likely to be direct or by reaction. If one supposes the balanced person to have an inbuilt tendency towards an entirely satisfactory equilibrium (which in the nature of things is unattainable) and that between experiences (whether artistic or otherwise) he is in a state of stability only approximate to that theoretical equilibrium[7]; and if one then supposes that an artistic experience (like real-life experiences) has the effect of disturbing this stability; then if that experience is revelatory

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6 Since our outlooks never correspond perfectly with actuality, to be immersed in the artist's outlook and then suddenly given (like a dose of cold water) a suggestion of actuality can make that actuality more uncomfortably alive than it seems in day-to-day life, when one is safely entrenched in one's own customary outlook.

7 i.e. the most efficient possible reactions towards experience. As far as I am competent to tell, these suggestions, though hardly couched in psychological language, are not inconsistent with the usual views of human psychology—except perhaps for the dogma of original sin!

of a better organized series of reactions than his previous equilibrium provided, his tendency will be (by acceptance) to establish a new and more satisfactory stability on coming out of the experience; if it is revelatory of a better organized series of reactions, but one less healthy owing to some falsifying inconsistency, his tendency may be (by reaction) still to establish a new and more satisfactory stability. What lawgivers in effect fear is that he may establish what is (from their point of view) a *less* satisfactory stability. I have seen it suggested that descriptions in good literature of what the writer regarded as perversions were more dangerous, because more convincingly done, than those in bad literature. Certainly good literature is more powerful: to say this is both a platitude and a truism. And it is reasonable to agree with I. A. Richards' *Principles of Literary Criticism* that this is because the sensibility of the author is better organized. Luckily, better organization tends towards better health. It must do so, because better organization simply means more complex, delicate and hence more resourceful and efficient reactions to experience. And where it does not tend to health, the propensity of readers being, as I have suggested, towards a better equilibrium, they will be more likely to react againt it than accept it.

For, if a book is to communicate, the outlooks of the writer and of the reader must not be too far distant. A subjective novel by a Martian, for instance, would be very difficult for a human being to comprehend. So it is likely that the attitudes of a pervert would (except to another pervert) communicate themselves as foreign and repellent. This does in fact happen; it is the reaction to most of de Sade.

Prudes and philistines tacitly admit the necessity of this sympathy between writer and reader in the arguments some of them use for banning all so-called "pornography"; for they go on to draw a horrific picture of what will happen if you don't. They seem to think that people only need to read of some "perversion" to be inspired to go out and act it. As if people's antisocial impulses were always uncontrollable and always there. This opinion doesn't say much for the state of mind of the people who hold it. Nonetheless, even those who consider the human mind (and particularly the female human mind) to be so tender a flower, are never themselves injured by the reading of pornography. Or at least, I have never come across anyone who claimed to have been.

I do not, however, accept the view held, or perhaps affected to be held, by so many supporters of the liberty of the printed word, and best exemplified by the famous, but anonymous, remark: "No girl was ever raped by a book." True, of course; but in its extreme form this view amounts to saying that literature has no influence and is of no importance, is, in fact, no more than a marginal frivolity. I do not accept this contemptuous view of the arts; and if one agrees with me in this, one must also agree that of course there is some danger involved in absolute licence, and of course it is possible for some people to be, if not corrupted and depraved, at least worsened slightly, by some books. This risk is, however, of a familiar sort, similar to the risk run by all

democratic societies in allowing freedom of political speech, and I have already given reasons for supposing it to be a very small one.

One of the difficulties in the way of discussing the subject sensibly is that the word "pornography" is itself an invitation for people to evode thought—which is probably a major intention behind its use. Since its meaning is so vague that it can be, and often it, applied even to frankness about normal sex behaviour, its implications are intensely prudish; so that another major intention in using it is to irritate one into accepting an argument on one's opponents' premises. I should prefer not to employ the word at all, it is so imprecise and misleading; and I have had to use great care in avoiding pointing this out until now. But one having done so, I cannot stop there. It is necessary to carry the war onto the opponents' ground, and assert that, even if one is not a Freudian believing in the identity of sex plus emotions and the libido, one must admit sex to be mysteriously close to the springs of life. Indeed, even to say this is to lay oneself open to the charge of talking metaphysics—and platitudinous metaphysics at that. The censors are aware of this too; or they would not be so eager to ban their "pornography". This being so, however, the treatment of sex in either a Lawrentian or a Rabelaisian way (contradictory thought the two attitudes are) can act with releasing and invigorating force. I am sure most people's experience of literature bears this out. Thus, to ban for instance the Rabelaisian approach, is to come dangerously close to banning the springs of life. The new Act under which *Lady Chatterley* was tried contrasts obscenity with literary qualities, the latter constituting an excuse for the former. But obscenity can itself be a literary quality.

And if Rabelaisian humour or Lawrentian earnestness are releasing and envigorating, this is true more or less of all shock tactics. Leaving out of account for the moment the healthiness or otherwise of the content of the shock, the administration of one is in itself healthy. After all, it is prejudice[8] that is the great enemy. Anything that upsets people's feelings, attitudes or opinions—or all three at once—even if it only upsets them to the extent of prompting them to rethink or refeel their adherence to them, is necessarily good. At least it has blown a layer of dust of their ideas. And there is no perfect outlook; the best we can hope for is that the approximations we achieve to it should become closer. The inertia of prejudice resists change, and every time a prejudice is questioned, the chance at least of some closer approximation supervenes. Hence this disturbing element in art is in itself valuable, in itself valid. "Science comforts," says Braque, "Art disturbs." Shock tactics are one of the artist's most powerful weapons in his constant struggle to excite, provoke and perturb.

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[8] I mean of course prejudice in its proper sense: opinions held for unreasonable reasons. For the purposes of this argument I would wish to stretch this to cover: attitudes and feelings felt for irrational motives.