LIFE AND QUANTUM PHYSICS

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In a book entitled *ESP—A Scientific Evaluation* C. E. M. Hansel[1] states (p. 17) that "in a parapsychology research, the process being investigated is both hypothetical and *a priori* extremely unlikely." Therefore, an alternative explanation, "provided it involves only well-established processes, should not be rejected on the grounds of its complexity or because it seems unlikely to be the true one." In other words, we are given the choice between two unlikelihoods, an *a priori* one, based on prejudice or limited knowledge, and the other inherent in the alternative explanation itself, and are invited to vote for the latter.

Quasars, neutrinos, the wave-particle duality, and most of subatomic physics are all "*a priori* extremely unlikely." Until fairly recently the sources of energy of the sun and other stars remained unknown and their performance could not be fitted into the established scientific framework. They went on shining. The argument from mere rarity is equally threadbare. Supernovae are extremely rare. There has not been one in our galaxy since the days of Kepler. True, modern telescopes reveal their occurrence in other galaxies; but they would still be there if these telescopes did not exist. On a smaller scale ball lightning suffers from the same difficulties in public relations as the more striking psychic manifestations, and is not understood. Rarity has nothing to do with reality: One elephant is just as real as a hundred elephants, and quite sufficient to establish the existence of elephants.

Hansel's plea is phrased differently by Hilary Putnam in *Minds and Machines.*[2] She says that "fundamental laws are like principles of pure mathematics (as Quine emphasized), in that they cannot be overthrown by isolated experiments: We can always hold onto the laws, and explain the experiments in various more or less *ad hoc* ways. . . ." In other words, as Ernst Haeckel is alleged to have said, "If the facts do not agree with my theory so much the worse for the facts!"

With this for an introduction we may tackle Jacques Monod's proposition that science is *objective* and not *projective,* i.e., the idea of purpose is unscientific.[3] I submit that all three terms: "science," "objective," and "projective" (in the sense defined) are used here demagogically.

Science is surely concerned with reality, quite *objectively,* which means that whatever observation and experiment reveal cannot be brushed under the carpet because it does not fit in with some preestablished set of propositions, as Putnam suggests, or excluded from examination, as Monod implies. It may be that the concept of metaphysical purpose is devoid of scientific meaning, as ideas on this subject are not falsifiable in Popperian terminology.[4] But on the ordinary level, purposeful activity, both in man and animals, is a matter of daily experience, and so legitimately belongs in the study of living things.

The mechanist's point of view is essentially *a prioristic* and metaphysical, and he seeks to escape from this situation by substituting teleonomy for purposefulness and behavior for consciousness.[5–7] This substitution is, of course, not valid, as consciousness implies a mind that is aware of what is going on. It does not do anything—it just *is.*

Teleonomy may be defined as unconscious purposefulness, arising from the evolutionary adaptation of an organism, both internally in structure and externally in behavior, through the blind forces of "chance and necessity," expressing themselves in random mutation and natural selection, which weeds out the unfittest.[8] Both these ideas raise a host of problems, some of which are recognized by Monod himself. Thus what strikes us as purposeful in living organisms and the way they act would be only the outcome of ages of adjustment to the environment.

A robot "tortoise" has been devised to simulate intelligent behavior in exploring a room, avoiding obstacles, and seeking out and plugging itself into an electric contact when its batteries run low, so that without knowing anything about its *modus operandi* we could not decide from mere observation whether it was conscious or not.[9] The tortoise has been programmed by its maker (who in doing the programming exercised his intelligence and consciousness) to react in certain ways to external and internal stimuli in a carefully contrived situation. It may, however, be argued that a real live tortoise has been similarly programmed by its evolutionary development, and is, in fact, a teleonomic automaton at a much higher level of complexity, which is only a matter of quantitative distinction.

This raises the issue of thought in cybernetic devices. Do they think?

The answer depends on what we understand by thinking. Cyberneticists limit themselves (arbitrarily) to the consideration of formal algorithmic reasoning, which moves from proposition to proposition according to predetermined rules on the binary yes-or-no principle. The introduction of a randomizing element or choice between alternatives, even if educable through trial and error, does not alter the fundamental principles of this organization. Some of our symbolized thought processes are very similar, and to this extent we, or our brains, behave like computers, and are indeed less reliable than these, inasmuch as our minds are in a constant state of flux, with stray thoughts, emotions, shifting attention, forgetfulness, and malassociation disturbing the regular algorithmic sequences. I will not go into Gödel's theorem here, which is again structured in the same abstract terms.[10] But there are such things as instant awareness, intuition, insight, and, of course, feelings and emotions intertwined with these and inseparable from thought, except by conceptual analysis. Algorithmic ratiocination is an artificial development, and we have never been quite at home with it. It has been suggested, rather frivolously, that a robot could be built which would evince pleasure—presumably by lighting a lamp—at the ingestion of strawberries with cream.[10] This is a meaningless behavioristic stratagem, and the fact remains that a cybernetic organization is incapable of other than algorithmic reasoning, which is in essence a mechanical process.[11]

Polanyi in his Gifford Lectures, delivered at Aberdeen in 1951–1952 and 1958, drew a distinction between *explicit knowledge,* formulated in words and other symbols, and the *tacit knowledge* of "what we are actually in the act of doing," and contended that the powers of animals may in the latter respect exceed ours, as our minds have been dulled at the tacit level (described here as "instant awareness") by the habits of verbalization and symbolization.[12] I am not prepared to argue for or against his thesis, but we, too, have the power of instant awareness, not only in the situations of danger, but even in the abstract academic sphere. It is quite common to understand intuitively, in a flash, a complicated mathematical proposition and to find it very difficult to prove it. Such understanding is not achieved by algorithmic sequences, which are only invoked later in a *post-mortem* examination after the conclusion has already been reached. If memory serves—and I am going at least 40 years back—this matter has been discussed by Henri Poincaré in *La*

Science et l'Hypothèse.[13] This is how most true discoveries are made. Nowadays, however, scientists are trained to think more and more like computers, which, I suppose, may be taken as a kind of self-implementation of an idea.

In fact, if the brain is a cybernetic machine it is a very peculiar one. In Penfield's experiments a "weakly stimulating electrode" was passed over an exposed part of the cortex, which caused movements of different parts of the body, but the control centers were not fixed and changed position according to circumstances.[9] The subject is aware of such movements not having been willed by him. The switchboard theory of the brain will not hold, as comparatively large brain damage has only minor consequences, the functions of the destroyed or injured neurons being taken over by other parts of the cortex. Up to 30% of it can be removed without an appreciable effect on general intelligence, which does not appear to be localized at all. In one case a woman had lost one hemisphere of her brain completely. Yet this did not affect such functions as binocular vision, which normally requires the cooperation of the two hemispheres. Nor did she lose her intellectual powers, except that she found the effort of thinking tiring.[7,14]

Plants have no recognizable nervous system, but they exhibit voltage fluctuations, which in such plants as *Mimosa pudica* and Venus's fly trap are associated with actual movements of parts of the body. Barbara Pickard, of the University of Washington, thinks that these are only amplifications of normal properties of all plants, as she has discovered regular voltage fluctuations, resembling action potentials, in morning glory and cocklebur. The pulses last from 100 to 400 milliseconds and occur at intervals from 1 to 10 seconds. Such functions as the induction of flowering seem to be controlled by them.[15]

V. B. Dröscher[16] reports that a plant, exposed for several days to a cold draught at 11:20 A.M. which caused it to droop its leaves, continued to do so punctually at 11:20 for a few days after this practice had been discontinued. Thus plants can be taught a behavior and have a kind of memory.

In the experiments made independently by Marcel Vogel and Cleve Backster a plant was connected to a lie detector and is said to have shown an emotional reaction to the experimenter's thoughts. In one of Backster's experiments the destruction of a plant by a student was witnessed only by another plant. In the subsequent "identification parade" that other plant was connected to a lie detector and evinced no reaction until the culprit appeared, whereupon the detector registered a violent agitation.[17]

These latter claims have been disputed and require confirmation, but they would seem to indicate not only sentience, but considerable intelligence and powers of perception, which in the absence of sense organs must be described as "extrasensory." From the point of view of the present essay it is important to note that these powers seem to be vested in individual cells, although acting in concert, possibly by induction or resonance.

H. Precht and Elke Lindenlaub made experiments with cats at Wilhelmshafen in 1954. The cat was put in an opaque bag and taken on a roundabout drive through the town, to be eventually released in a maze with 24 exits. 142 cats were thus tested, and in almost every case the cat emerged from the maze through the entrance facing towards her (or his) home. Mice have comparable direction finding ability, as do homing pigeons. This ability does not seem to be based on a magnetic sense.[16]

It may be noted here that, although our nervous systems operate with very weak electric currents, we experience no disturbance when exposed to strong radio waves or in proximity to powerful electric machinery, so that the basic operant does not seem to be electromagnetic. In the experiments with telepathy made at the Paraphysical Laboratory at Downton, Wiltshire, England, the scores went up when the recipient was enclosed in a Faraday cage, excluding electromagnetic waves.[7]

Monod's definition of science must be understood in the historical context of the emergence of the modern scientific mind from earlier magical habits of thought, with the tendency to interpret all events in personal, or animistic, terms. The latter has by and large proved to be mistaken: Physical phenomena can generally be accounted for by impersonal, and so "objective" and not "projective," or purposeful, causes. This, however, does not apply to hypnosis, whose reality has long been acknowledged, and which remains essentially magical and unexplained.

In A. H. C. Sinclair-Gieben's experiment at the University of Aberdeen, warts were willed away from one hand of a patient by hypnosis, while the other hand, used as control, remained unaffected.[18] Warts are a virus complaint. A. A. Mason's hypnotic cure of "crocodile skin," a very serious condition which had resisted conventional medication, is another well-known similar case.[5] J. A. Hadfield, a London psychiatrist, has reported on the case, observed critically under hospital conditions, of a seaman suffering from combat hysteria. When touched with a finger under hypnosis, and told this was a red-hot poker, the seaman winced violently, and after a while a blister appeared at the touched spot and filled with a large

quantity of liquid. Conversely, he felt no pain on being touched with a red-hot iron rod under an opposite suggestion, and the blisters which formed were very small and healed rapidly. Another London psychiatrist, R. L. Moody, had a female analytic patient, who had been cruelly beaten in the past, and when, during treatment, she relived the experience weals appeared on her body where she had been hit.[19] Psychosomatic diseases are well known, and clinical examples of this nature can easily be multiplied.

They are not as rare as supernovae and are equally well documented. They come very close to conventional magic, and certainly demonstrate the powerful influence the mind can have, not only on one's own body, but on those of others.

To return to Monod, he stresses the invariance of organisms as a salient feature of life, and goes on to observe,[20] "as to invariance, its mechanism is well enough known today for us to affirm that no nonphysical principle is required for its interpretation." The assertion of the vitalists to the contrary arises "not from precise knowledge or from definite observations, but only from our present-day ignorance." This seems to be a kind of reversible ignorance that instantly turns into firm knowledge when required. I have no doubt that Monod's knowledge of biochemistry is vastly superior to mine, but overspecialization presents the disadvantage of narrowing one's angle of view. An overspecialized investigator tends to miss relevant data from other fields of study. To begin with, the term "nonphysical" may be given a variety of interpretations; for instance, John Taylor accepts telepathy and some other paranormal phenomena, but still classes them as "physical," i.e., amenable to study by the science of physics, which is a justifiable viewpoint.[7] It is clear, however, that what Monod implies is classical physics, which is a very different matter. Further, the impugned "assertion of the vitalists" may not be based on test-tube experiments of the kind he has in mind, although even this is open to doubt, as we shall see presently. But I have adduced a number of instances of mental influence on cells and tissues on a macroscopic scale, which is surely relevant, so that this accusation is grossly unfair.

However, Monod writes in *Chance and Necessity*, on page 65: "From . . . what is known of cellular metabolism we can tell that even if at each step each enzyme carried out its job perfectly, the sum of their activity could only be chaos were they not *somehow* interlocked so as to form a coherent system. . . ."[3] *Somehow!* How about that for ignorance? Moreover, how would he explain, physically or nonphysically, the behavior of the chromosomes in

mitosis?[8] All we know about it is that they "gyre and gimble in the wabe." He does, in fact, refer to the idea of "morphogenetic field," introduced by embryologists, and speaks of certain cell organelles, such as ribosomes, forming themselves spontaneously, as though this called for no further comment.

The action of such a morphogenetic field is poignantly exemplified by the experiments of Richard Sidman and G. R. Delong at Harvard, who had gently teased apart the cells in the developing brain tissue of a mouse embryo and placed these in test-tube cultures, where the cells rearranged themselves spontaneously in the correct original order.[21] This is, indeed, a very strange field, because it is structured without obvious focal points, such as an attracting mass or charge. It recalls the immaterial spatio-temporal organization invoked by Sir John Eccles to explain the working of the brain.[14] The organization appears to be largely independent from the material substratum of the cortex, and can migrate as it were "bodily" from its one part to another, especially in cases of local injury. In fact, such morphogenetic and cerebral fields seem to resemble an "ethereal" or "astral" body. What kind of interactions, what kind of physics would be required to account for such behavior?

One obvious reflection is that knowing the parts of a functional whole is not the same as understanding this whole. There are various levels of interpretation, relevant to and dependent on the methods of inquiry. We may imagine an extraterrestrial intelligence coming into possession of a printed copy of *Hamlet.* This intelligence may be unfamiliar with books or written language. It would weigh, measure, and analyze the materials of the pages, cover, and printing ink, describe the printed symbols and their arrangement. All this would be perfectly valid information, but what would it tell us about the Tragic Prince of Denmark? In biochemistry and other life sciences we are often confronted with a similar situation.

There is truth in the teleonomic interpretation of living structures and instinctive behavior, but this does not preclude consciously willed, purposeful action, which if sustained as a habit can have cumulative evolutionary effects.

Great fun was made of Lamarck's idea that giraffes have acquired their long necks as a result of trying, or wanting, to reach the crowns of palm trees. In the orthodox Darwinian view (about which Darwin himself was in doubt) this has come about through random mutation and natural selection alone. If so, however, it is hard to see why the gnu, sharing the same habitat and having been exposed to the same

forces, should have such a short neck. Natural selection—and for this once Monod agrees[3]—could not have worked to lengthen the giraffe's neck unless the giraffe tried, or wanted, to feed on high tree leafage. An accidentally lengthened neck could not have conferred on it any selective advantage in the absence of such a habit. Similarly, the otter did not first develop webs between its fingers and then take to the water, but the other way round.[21]

The importance of habit, and ultimately desire, in evolution has been recognized by many modern thinkers.[1,8] Thus the Lamarckian and the Darwinian interpretations are not mutually exclusive, quite apart from the increasingly apparent possibility of a feedback from the environment to the genomes and even direct influence of thought on the DNA. After all, if it can produce blisters and cure crocodile skin, it could affect the nucleotides in the DNA, although it would be biologically desirable not to allow such influence too much scope.

Much of our thinking has been dominated by the Aristotelian principle of the excluded middle: It must always be either or, which is very seldom the case in reality. In the so-called "exact sciences," based on mathematics, the laws are artificial mental constructs of concepts abstracted from observation and experiment, i.e., controlled observation. The constructs are formed according to certain rules, which apply to systems of concepts by definition, and so are arbitrary in essence.[4,9] Abstraction implies selection of what is regarded as the most important, but we may be no better served by it than that extraterrestrial intelligence which thought the composition of the printer's ink to be the most important part of *Hamlet.*

Moreover, owing to the particulate structure of matter and energy, science has generally to deal with large averages, the individual behavior of whose elements is random "in the meaning of the Act," even in classical interpretation. The gas laws are not applicable to small numbers of molecules or atoms. The laws of chemistry have similarly been derived from experiments with very large numbers of molecules and atoms, and are subject to the same limitations. They do not apply to individual particles even in the framework of classical physics, within which Monod's thoughts appear to move while he pays lip service to the quantum theory.[3] The latter makes the behavior of individual particles intrinsically unpredictable.

I will return to this at a later stage. Enough that the laws of nature can at best be statistically valid. Their degree of accuracy may be very high for sufficiently large averages, but they still admit of exceptions.

Now, although the processes which sustain life can occur "naturally" in the inorganic universe, they are infrequent, slow, inefficient, and usually ephemeral. In a living organism, however, they are amplified beyond computation by triggering sequences acting on delicately balanced systems in labile equilibrium. This is quite contrary to all laws of nature, which describe the most probable behavior of large numbers of elements. In fact, an organism is an organization of statistical improbabilities,[23] and if such an organization arose by mere chance it would soon follow the arrow of time to that enzymatic chaos envisaged by Monod and mentioned above, in the absence of some controlling agency. Yet organic structures not only persist, but perpetuate themselves with the relative, but nevertheless impressive, invariance which Monod professes to understand so well.

Small triggering impulses acting on complex situations in labile equilibrium are the governing scheme of life. The retina of the human eye is capable of responding to a light pulse of two or three photons.[9] This falls entirely within the range of quantum mechanics, and may be taken to typify the order of energy exchanges involved in the triggering impulses of the nervous system. Moreover, the retinal response is cumulative, so that these two or three quanta need not arrive all at once, and a single quantum will suffice to make a neuron discharge. This has led Sir John Eccles to describe the brain as a "machine a ghost might operate."[14]

It may be natural enough for Monod to think of an organism as a "chemical machine," but his obsession with structure is shared by people holding views diametrically opposed to his, and in this case by Sir John. Indeed, structure is fundamental to machines, whatever emergent characteristics these may display, inasmuch as the performance of a machine is the direct outcome of its structure. The concept of structure is essentially static. A machine can perform if actuated, but it need not perform. This does perhaps resemble the behavior of a virus, whose true aliveness is in doubt on this score. An organism, however, is no machine, not even one operated by a ghost: It is an event propagated by continuous change in the four dimensions of space-time. Its "structure" is like that of a river, which is never the same and cannot be stepped into twice, in the words of Heraclitus. The real essence lies in the processes: The structure is only the product of the processes, seen in time cross section, like a snapshot.[23]

The problem which life has had to solve is how to ensure the continuance of the processes which maintain, and are contained within, the external form we call an organism. This has been done

by cyclic processes in which the initial constituents are renewed, and even multiplied, after passing through a series of chemical reactions. A very delicate state of balance, constantly lost and regained, is being maintained by a most elaborate arrangement of checks and counter-checks, so ably portrayed by Monod. I have described this as "running in circles to stay put."[23] But the question remains, *Quis custodiet ipsos custodes?*

It may be contended, and he certainly does contend, that no overriding control is necessary; it all happens automatically, or teleonomically, which may be partly true. Yet we have seen an overriding control in operation in the form of a "morphogenetic field" which reshuffled the separated cells from the brain of a mouse embryo back into their allotted stations.

In any event the automatic, teleonomic self-balancing system must be highly reliable, to ensure *inter alia* that genetic invariance. Yet if we examine actual living beings we find that they are made up of cells, which are controlled in their functions by single molecules or groups of molecules and energy exchanges at the quantum level, so that such controls are intrinsically unpredictable and unreliable. On any straight reckoning this must result in chaos.[24]

On the other hand, there is no intrinsic difficulty about macroscopic controls above the level of quantum mechanics, and of a high degree of reliability. Life, however, has not followed this obvious course. The largest unicellular organism, which possesses all the essential properties of the metazoon, including eyespots and thus sight, is about a quarter of an inch, say, 6 mm, in its greatest dimension.[8] One possible objection to macroscopic control is evolutionary inflexibility, but this cannot exorcize the ghost. Clearly, a biological organization is not viable without the quantum uncertainties in its controlling apparatus, which seem necessary for the guiding forces to intervene effectively in the business of life. This alone can teleonomically justify such a system.

It is here that the great importance of Helmut Schmidt's experiments lies.[25–28] They show that the mind is capable of influencing to a statistically significant extent intrinsically unpredictable events at the quantum level, and that in the very unpromising situation of nuclear fission.

It is hardly surprising that the effect of the mind on the fission of atoms is very weak; it is rather to be wondered at that there should be any effect at all. It must inevitably be much stronger on biological systems, which have evolved teleonomically to respond to mental influence. Indeed, the clinical cases I have cited clearly show that

cells and tissues can be affected by thought even on the gross, macroscopic scale, although this would be generally undesirable from the biological standpoint, and suitable defense filters must have been evolved to shield organisms against outside mental interference. Only when these defenses are temporarily lowered in a hypnotic trance, under physical or emotional stress can the cerebral mind, whether the organism's own or external, throw the biological control switches in the desired, or feared, direction. The negative effect is just as important as the positive, and is clearly present in psychosomatic diseases and in Schmidt's experiments as well.[25-28]

The mental action in these experiments must not be confused with psychokinesis, which consists in the movement of macroscopic masses, even if the ultimate basis of both types of phenomena be the same. What happens is the loading of probabilities in the quantum mechanical equations: The effect is on the psi function. If sustained in a definite direction, this can result in statistically improbable behavior of matter and energy. Such behavior does not *violate* the laws of physics, which are those of large averages and greatest probabilities, but it gets around them, as their validity depends on complete randomness, and so maximum disorder, at the elementary level. I have described an organism as an organization of statistical improbabilities, and the ideal, probably the only way, this can be achieved and sustained is the directive organization of forces of mental order, as expressed in morphogenetic and cortical control fields. The DNA would act here as a kind of receiver and translator of the governing genetic idea, as though it were a mini-brain with an extremely one-track mind, related to but distinct from the conscious mind manifesting itself in cerebral processes.

It seems that the nature, origin, and organization of life necessitate an intervention of mental forces. We cannot do without a "ghost."

I can do no better than close with a quotation from the late J. B. S. Haldane: "The fact about science is that everyone who has made a serious contribution to it is aware, or very strongly suspects, that the world is not only queerer than anyone has imagined, but queerer than anyone can imagine."

REFERENCES

[1] C. E. M. Hansel, *ESP—A Scientific Evaluation* (MacGibbon & Kee, London, 1966).
[2] Hilary Putnam, *Minds and Machines,* edited by A. R. Anderson (Prentice-Hall, Englewood Cliffs, N.J., 1964).
[3] Jacques Monod, *Chance and Necessity* (Collins, London, 1972).
[4] Sir Karl Popper, *Objective Knowledge* (Clarendon Press, Oxford, England, 1972).

[5] John Beloff, *The Existence of Mind* (MacGibbon & Kee, London, 1962).
[6] C. D. Broad, *The Mind and Its Place in Nature* (Routledge & Kegan Paul, London, 1951).
[7] John Taylor, *The Shape of Minds to Come* (Michael Joseph, London, 1971).
[8] G. G. Simpson, *This View of Life* (Harcourt, Brace & World, Inc., New York, 1964).
[9] A. M. Munn, *Free-Will and Determinism* (MacGibbon & Kee, London, 1960).
[10] *Minds and Machines*, edited by A. R. Anderson (Prentice-Hall, Englewood Cliffs, N.J., 1964).
[11] Ian Benson, New Scientist **51**, 525 (1971).
[12] J. R. Smythies, *Science and ESP* (Routledge & Kegan Paul, London, 1972).
[13] Henri Poincaré, *La Science et l'Hypothèse* (Bibliothèque Philosophique, Paris).
[14] Sir John Eccles, *Facing Reality* (Longmans-Springer, London, 1970).
[15] New Scientist **58**, 312 (1972).
[16] V. B. Dröscher, *Mysterious Senses—An Enquiry into Animal Perception* (Hodder & Stoughton, London, 1964).
[17] New Scientist **59**, 347 (1973).
[18] A. H. C. Sinclair-Gieben, New Scientist **9**, 736 (1961).
[19] D. J. West, *Psychical Research Today* (Duckworth, London, 1954).
[20] Reference 3, p. 36.
[21] Sir Julian Huxley, *Evolution. The Modern Synthesis* (Allen and Unwin, London, 1963).
[22] New Scientist **53**, 6 (1972).
[23] V. A. Firsoff, *Life among the Stars* (Wingate, London, 1974).
[24] V. A. Firsoff, *Life, Mind and Galaxies* (Oliver and Boyd, Edinburgh, 1967).
[25] Helmut Schmidt, J. Parapsychol. **34**, 255 (1970).
[26] Helmut Schmidt, J. Appl. Phys. **41**, 462 (1970).
[27] Helmut Schmidt, New Scientist, 114, 16 October 1969.
[28] Helmut Schmidt, New Scientist, 757, 24 June 1971.

DISCUSSION

WALKER: I did not quite understand how you envision that the mind controls events in such phenomena as the decay of atoms, as in Helmut Schmidt's experiments.

FIRSOFF: Well, it clearly does, doesn't it? The mind obviously controls phenomena, because the probability has shifted, operating according to a certain order which is willed, consciously or unconsciously. However, I think of mind not only as the conscious mind, but mind as a force, which acts throughout the cells, at lower levels as well.

WALKER: Are you saying that the mind acts as a force, directed like an electric field, to produce effects that are manifest outside the body?

FIRSOFF: I think that there is a mind field, which acts both within the body and outside the body, and can cause various effects. Then, to sustain such effects as, say, clairvoyance and psychokinesis, it is

necessary for matter to possess mental attributes, because otherwise there could be no common interaction between the mind and matter.

WALKER: Would you predict that the inverse square law or any similar law applies to such a field?

FIRSOFF: Not necessarily. The effect may be directed, say, like a laser beam, in which case it would be attenuated exponentially.

WALKER: One of the difficulties encountered in the case of clairvoyance, for example, is to determine how any field of this sort is not only capable of interacting with targets that are remote, but produces an image that very much resembles the effect of ordinary visual interaction. For example, let us assume that the brain contains a radar device that can send a signal through a wall or similar barrier. Any such theory would still have great difficulty in explaining how the reflected signal can be imaged.

FIRSOFF: This is of course completely outside my essay, but our ordinary perceptions are structured in our minds. They are not present as such within our senses. It is only our mind that structures them into pictures of a certain kind, or interprets them. So if we have an input of a psi type, this perception would also be structured in our mind according to our experience and other data. However, I do not offer a final solution to the problem.

FEINBERG: I want to make one remark on the distinction that you have drawn between psychokinesis affecting the motion of things and, on the other hand, human beings affecting the probability of events.

The point is that modern quantum mechanics is essentially concerned with the probabilities that are affected. That is to say, the notion found in Newtonian physics or even earlier versions of quantum mechanics that there are forces which move things has somehow been replaced, or reexplained if you like, in terms of local interactions between the objects we think make up the world, the elementary particles, and these local interactions are typically of the form that they affect the probability that one or more elementary particles change into one another. Therefore, it strikes me that if there is an effect of the mind on probabilities of the kind that you mention and that Dr. Schmidt's experiments seem to suggest, then it is hard to imagine that such an effect could not also, and would not also, have the further effect of causing motions of things.

One particular illustration that struck me is that if the mind can

vary the rate at which radioactive atoms decay, then almost certainly it would also affect other things about the decay. For example, it would affect the distribution of energies of the radioactive particles that are emitted. Now, that may or may not be easy to measure. It depends how large the effect is. If there is a 10% effect on the probabilities, then for some kinds of decay, like alpha decay, there will be a very small effect in the energy. On the other hand, for other kinds of decay, e.g., beta decay or gamma decay, the effect on the energies, i.e., certain parameters of the energy distribution, would be comparable to the effect on the decay rates, and it might be quite possible to measure these effects, as well as the effect on the probability.

FIRSOFF: I agree with this entirely, and in fact I did suggest that the basis for both phenomena is probably the same. I stress this difference—it's really a semantic problem rather than a real one, because I describe an organism as an organization of improbabilities, rather than emphasize the movement of masses. But I entirely agree with what you say.

BEAUREGARD: I suppose we all agree that the mind field is not a force field. It is a probability or information field. However, all these phenomena which modify probability imply something akin to the use of advanced waves, as I stressed in my lecture. Going away from the law of blind statistical prediction that is usual in statistical physics, and introducing the weighing of probabilities, as you have done, and as Helmut Schmidt does in his paper, means that you are moving away from pure retarded waves, and introducing a contribution from advanced waves.

FIRSOFF: Well, I'll go further than that. I have a paper which reinterprets inertia in different terms. On this basis, I can show that the universe is not expanding. If it is not expanding, then it is practically eternal or extremely old. For the universe to exist in this condition, it must be what I have christened a "Le Châtelier" universe in which all processes exactly balance, i.e., the generation of entropy and negentropy cancel out. Otherwise, it could not survive, and would have ended a long time ago.

BEAUREGARD: Yes, it would inevitably end.

SCHMIDT: With regard to the question of whether you affect radioactive decay directly or other physical parameters like the energy levels or the sensitivity of the detector, one testable working hypothesis is this: PK affects the system so as to obtain most

economically the desired feedback. That means in particular that processes which are statistically independent of the feedback are unchanged.

FEINBERG: The ordinary description of decay specifies a relationship between the decay rate and the width of spectral line which is emitted, e.g., the energy dispersion of the emitted particle, which is given essentially by Heisenberg's principle. Now, if the observed decay rate is changed by some amount, then the most naive expectation would be that the dispersion would change similarly, assuming that Heisenberg's principle is valid.

These assumptions might be wrong, of course. One factor might change while the other one doesn't. However, it would be interesting to know about that.

FIRSOFF: My fundamental conception is that life at the elementary level demands statistical departure from randomness because otherwise you won't get the organization of improbabilities. It need not be a very high departure. It may be quite small. It will still work even if the departure from randomness at the elementary level is quite small.

SCHMIDT: Your statement would really be very difficult to support, because life is so complex. We need to learn so much more about molecular reactions. I would say that your conception is suggestive, but not a hard argument with which all people would be forced to agree.

FIRSOFF: Well, perhaps not. Mass reactions may progress in two directions, while the individual events that underlie them are unpredictable. If, say, you have an ionic reaction, association and dissociation occur at the same time. And that is all right; if you take a very large number of molecules, the one or the other trend will prevail to a predictable degree. But if you have only two or three, they may not react at all, and the probabilities are equally good that they will dissociate instead of associate.

WALKER: Dr. Feinberg has mentioned a very interesting kind of experiment that could be carried out. However, I would predict that you will not find an effect on the energy of the decaying particles, even for great shifts in the probability, unless that outcome is made the target for the subject. Energy values that differ somewhat from the most probable state could be selected from the distribution of energies that one does measure. However, the equations that I gave present relations which make it possible to calculate the energy shift

to compare with the change in the rate of decays that are measured. This means that if there are two parameters and either one could be used as the target, there would be a relationship that can be easily calculated from my theory to tell what would happen if the first or second parameter is used as the target. Generally, however, according to the theory, unless the subject is told that the target is a shift in the energy, you won't get a shift in the energy.

SCHMIDT: There is one great problem in parapsychology that arises if the experimenter even begins to look for this effect and the subject knows that. Even the expectation of the experimenter may have an effect. Therefore, these hypotheses are very difficult to verify.

WALKER: The reason being that the experimenter is as much the subject as the person that he is working with.

FIRSOFF: I think the negative effects are important here. If you get a negative effect with one subject, and positive with another one, this provides a check on the experimenter's influence. The experimenter cannot will one effect both ways at the same time.

SCHMIDT: But one also has subconscious expectations, motivations, and the desire to succeed of the experimenter, which makes verification difficult.

HILL: Dr. Firsoff, as you pointed out, the more highly ordered structure of living systems is completely unexpected, from what we know about entropic considerations of mechanical systems. In the past certain authors have expressed more mystically-oriented principles like entelechy to explain this. I would like to ask you if you have any thoughts on perhaps a more physical source of this order?

FIRSOFF: No, I am afraid not. I confess ignorance. I have some ideas, but I don't know how it works, except that the mind force is involved. That is a very vague statement which cannot be condensed into an equation or anything like that.

BASTIN: I am a bit alarmed that we may be jumping to an unwarranted conclusion. Although it seems very natural to assume that these phenomena affect the quantum level directly, it is merely an assumption. It is an assumption that I hope is right, and my paper, which describes very briefly some experiments done at Birkbeck College, goes into the matter a bit. We have been speaking rather unguardedly of the fact that Uri Geller could influence the rate of counts in the Geiger counter. Well Hasted and Bohm went

into this question in some detail and concluded that if one is going for the most conventional postulate first, one ought to postulate that Geller produces a strong current which is sent through the shell or casing of the Geiger counter. With the instrument we used this would have given the observed effects.

I don't myself think it's necessarily correct to go for the least upsetting hypothesis that meets the case, but I just put this difference of opinion on record.

TARG: I want to respond to Harris Walker's comments. I don't think we should abandon hope of the possibility of doing physical experiments that involve a cause and effect relationship. For example, I think that the lifetime of nuclear decay is inexorably related to the spectral width and probably the most provocative thing that I remember from this conference two years ago is a comment by Helmut Schmidt that in all parapsychological experiments, and particularly in psychokinetic ones, the result is goal-oriented rather than means-oriented. This is really a profound insight and is also true, as anyone who has done experiments in this area can verify.

That doesn't mean, however, that we have to give up finding physical relationships. I think that Ted Bastin's comment is probably right, that one will find that Geller was able to affect the work function, or the ionization potential, or some other regular property of the Geiger counter, to cause the counter to run away in an avalanche, producing more counts. If that's true, then I would say, in addition, Ohm's law operates. That is, with the increased current, one would observe concomitantly that the voltage falls.

Similarly, in an experiment in our laboratory at Stanford Research Institute where Geller was trying to cause a pen to deflect, one got all the various concomitant things that you would expect. For example, if you're looking at a psychokinesis experiment which is monitored by a number of different observables at different stages in the apparatus, and you then get an observable, you would expect each of the various parts of that apparatus to function in a way to indicate that the observable had taken place.

WALKER: I have been misunderstood on this point. I did not say that one cannot get physical correlations. As a matter of fact, I stated very specifically that you can hope to do this, and that there will be certain things that you can predict. There are certain cases and experiments where it can be stated flatly that one will not get a particular kind of effect. Energy will be conserved in the whole

system. So I am stating that although the subject affects the target, and a reading is obtained, conservation of energy in the system will not be changed.

One the other hand, in other types of experiments, as you mention, one certainly should expect to find all the various correlated effects associated with the functioning of the Geiger counter or the detecting of a particle.

Each of the particular experimental setups that one might treat must be dealt with as a separate problem, as you would do in almost any area of physics: One should calculate what is predicted by the theory, and then run the experiment.

TARG: I'm sorry for any misunderstanding. In a preliminary experiment with Uri Geller in which we have very high confidence, Geller was asked to move a pendulum, which was monitored by and through a chart recorder, with which we were very familiar. And the interchange went something like this: "Oh, you want me to move the pen on that recorder?" We said, "No, we want you to move the pendulum." He said, "Well, the chart recorder will show it, right?" He raised his hand in a sort of great salute and said, "I'll do it right now." He cracked his knuckles, and both pens on our chart recorder went to the right side of the page. We discovered that the two input amplifiers on our Sanborn recorder had chosen to burn out at that moment.

So that was presumably the line of least resistance in the particular experiment. And I wouldn't think for a moment that it was the result of a tremendous motion of the pendulum, but rather the result of the weak link in the system.

WALKER: The other case has to do with conservation of energy, and that comes more directly out of the whole business.

MATTUCK: Dr. Beauregard said that he believes everybody agrees that mind does not act as a force field, but rather as an information field, and about three minutes after that Professor Firsoff said that mind is a force field. So I wonder how much agreement there is on this subject. If there is an interaction between a quantum mechanical system and mind, there has to be some interaction operator, and this would imply that some sort of force is involved. On the other hand, if some sort of hidden variable theory is held, this means that the things that are being talked about go outside of the realm of quantum mechanics.

So if mind is a force field, and functions as an interaction operator, namely, the Hamiltonian for an interaction between mind

and the quantum mechanical system, then it seems to me that such a force field could eventually agree with the laws of quantum mechanics as they exist today, except for the addition of a new force.

On the other hand, if you have a hidden variable theory in which consciousness acts in some way as a hidden variable in its effect on quantum systems, then it seems that you go outside of the realm of quantum mechanics.

BEAUREGARD: I am convinced that we do not change the Hamiltonians. They are what they are, and that's all. The Hamiltonian that describes the interaction between the photon that is received and your eye is just the same whether you are or are not doing parapsychology. It is solely a question of weighing the probabilities or, in other words, of accepting a contribution from advanced waves.

PIRON: You have indicated merely one model which serves your purpose, although other models can be built. Conservation of energy can be maintained if another variable is put in the Hamiltonian, because the Hamiltonian is Poincaré invariant. However, if this new variable is added, the same effect as before cannot be claimed.

WALKER: I want to thank Professor Piron for having essentially answered the question, as far as my view is concerned. I would like to say that the choice of the term "hidden variable," which has been forced on me by the past literature, is somewhat unfortunate. The hidden variable, the concept as introduced by Bohm, was introduced really for the purpose of stating that there would be a new formulation of quantum mechanics coming in the future that would involve new variables which at present are of a hidden character. Perhaps for my usage the term "true hidden variables" would be better, or variables that can be introduced and, providing it is done properly, do not really change the present formulation, but do serve to collapse the state vector.

MATTUCK: In other words, are you saying that there are extra variables?

WALKER: Yes, there are, the same as Professor Piron maintains.

BASTIN: I just wanted to say to Professor de Beauregard that it seems to me almost odd that you should be so convinced you know what is inside your system, and what—lying outside it—can be varied. What is so special about probability or information, that they can be manipulated, whereas the Hamiltonian is sacrosanct?

BEAUREGARD: I mean that when one does a parapsychological experiment, the Hamiltonian is not changed just at that time.

BASTIN: But you do allow the probability to change?

BEAUREGARD: What I'm saying is that in all ordinary physics that obeys the second law, systematically blind statistical prediction is used. But I say that there is still another theoretical possibility, which requires, in the exact opposite case, using blind statistical retrodiction. This is extremely paradoxical but perfectly legitimate on the mathematical level. I believe that all processes of willing or precognition belong to this type, and are based on advanced wave solutions, or probability decreasing solutions. That is, of course, my conjecture.

PUTHOFF: My question is also directed to Professor de Beauregard. I am interested in what you think the actual mechanism is for pulling in advanced waves. Does it specifically involve cooperative precognition of the monads?

BEAUREGARD: No new mechanism is necessary. Exactly the same mechanism is required as in usual physics. However, one just works with the opposite solutions. Then, by definition, the mechanism is not causalistic but finalistic, because instead of having sources of retarded waves, one has sinks of advanced waves. That is the entire difference. Apart from this, everything is identical.

PUTHOFF: So you don't require that at some time before the sink there was. . . ?

BEAUREGARD: No. I think quite seriously that the universe is time-extended.