[5] René Daumal: *Mount Analogue.* An Authentic Narrative. (Transl. and intro. by Roger Shattuck; postface by Véra Daumal.) London: Vincent Stuart, 1959. New York: Pantheon, 1960. [*Le mont analogue.* Préface par Rolland de Renéville, récit véridique. Paris: Librairie Gallimard, 1952.]

[6] Bernhard Zeller: *Hermann Hesse: Eine Chronik in Bildern.* Frankfurt a.M.: Suhrkamp, 1960.

[7] *Magister Ludi* (*The Bead Game*). (Transl. Mervyn Savill.) New York: Holt (1949); Ungar Paperback (1957). (Quotes from pp. 17, 39, 10, 500-1, 355-6, 359, 367.) [*Das Glasperlenspiel.* Versuch einer Lebensbeschreibung des Magister Ludi Josef Knecht samt Knechts hinterlassenen Schriften. 2 vv. Zürich: Fretz & Wasmuth, 1943. Frankfurt a.M.: Suhrkamp, 1961.]

[A complete listing of Hesse's works and the critical literature on him is available in Helmut Waibler's *Hermann Hesse: Eine Bibliographie.* Bern und München: Francke, 1962. Pp. 350.]

Did Hesse use mind-changing drugs?

Although the argument of the preceding commentary does not depend on the answer to this question, there are sufficient clues in Hesse's writings to make the matter of some historical and literary interest. In Germany, at the time Hesse was writing, considerable research on mescaline was going on. This has been reported in a monograph by Kurt Beringer *Der Meskalinrausch.* Much of the material was also analyzed in Heinrich Klüver's monograph, *Mescal,* the first book on mescaline published in English.*

In response to our inquiry, Professor Klüver, now at the University of Chicago, has written:

> To my knowledge Hermann Hesse never took mescaline (I once raised this question in Switzerland). I do not know whether he even knew of the mescaline experiments going on under the direction of Beringer in Heidelberg. You know, of course, that Hesse (and his family) was intimately acquainted with the world and ideas of India. This no doubt has colored many scenes in his books.

Readers of the journal who have any further information bearing on this question are invited to communicate with the editors.

* *Mescal.* The 'Divine' Plant and Its Psychological Effects. London: Kegan Paul, Trench & Trubner, 1928. (To be reprinted late 1964, Univ. of Chicago Press.)

Psychometabolism

SIR JULIAN HUXLEY[1]

As a mere biologist, I felt somewhat alarmed on being asked to talk on psychological matters to a gathering of psychiatrists. I eventually decided to approach the subject in the general perspective of evolution, and to speak about the role of mind as an operative factor in the evolutionary process.

If we look at the process of biological evolution as a whole, we will see that it tends toward the production of types which can utilize more of the world's space and material resources more efficiently. To achieve this, new types of metabolic utilization appear. The most fundamental metabolic divergence was that between green plants and animals. Later, there developed many new types of metabolic systems, capable of utilizing new materials. Termites, with the aid of their intestinal protozoa, can utilize wood; ruminants can utilize cellulose with the aid of their bacterial flora and protozoan fauna. Sometimes greater efficiency of exploitation is attained by symbiosis. The most famous case of such symbiosis between complementary metabolic systems is that of the lichens, which are mixed organisms, part algae and part fungi.

It is important to note that these metabolic novelties may produce results which affect the further course of evolution, by altering or even increasing the material resources available for future generations. Thus during much more than half the period of life's evolution on earth, there was no wood. When abundant wood was eventually produced by large green terrestrial plants, it provided the material for a new type of metabolic exploitation by termites. Again, once terrestrial vertebrates had produced keratin in bulk, the opportunity arose for the evolution of clothes-moths. This type of cybernetic feedback is a regular feature of the evolutionary process.

The other major tendency in biological evolution is manifested in the evolution of mind, a trend towards a higher degree of awareness. This is especially marked in the later stages of the process in the dominant types of animals, notably insects, spiders and verte-

brates, and is of course mediated by their brains. Brains can be regarded as psychometabolic organs. Just as the physiological metabolic systems of organisms utilize the raw material provided by the physicochemical resources of the environment and metabolize them into special material substances, so brains, more highly developed, utilize the raw materials of simple experience and transform them into special systems of organized awareness.

This at once brings up the perennial problem of the relation between mind and body. We must first remember that the only primary reality we know is our own subjective experience. We can only *deduce* that other human beings have similar subjective experiences. This is perfectly legitimate, both logically and scientifically. It is also necessary pragmatically; life could not go on otherwise. We are sometimes able to detect and prove differences in other people's possibilities of subjective awareness, as, for example, with color-blindness or "taste-blindness." But in general we quite legitimately deduce that other human beings are conscious and have minds similar to ours, because they are made in the same sort of way and behave in the same sort of way, and because that is the only basis for understanding them and co-existing with them.

The only satisfactory approach to the general problem is an evolutionary one. We begin with man as an organization of *Weltstoff* — the stuff of which the universe is made. The human organization has two aspects: first, a material one when seen from the outside, and secondly a mental or subjective one when experienced from the inside. We are simultaneously and indissolubly both matter and mind.

Extending our survey to higher animals, it is not only scientifically legitimate but obvious that we must ascribe subjective awareness to them, as Darwin did in his great book *The Expression of Emotions in Man and Animals*. It is all too obvious for the higher apes. It is equally legitimate to say that mammals such as dogs must possess a marked degree of subjective awareness; otherwise, indeed, we should not be able to interpret their behavior at all. We can extend the principle to lower vertebrates with a high though lesser degree of certainty. Indeed, I do not see how you can refuse some sort of subjective awareness to higher invertebrates such as bees and ants. This, however, poses an extremely interesting neurological problem — how are bees and ants capable of their extremely complex behavioral activities? For instance, bees have a symbolic language, yet their brain is no bigger than a pin's head, with a number of neurons

many orders of magnitude lower than that in any vertebrate brain.

The legitimacy and indeed the necessity of extending the capacity for awareness to less complex organizations than our human selves is equally obvious when we consider our own development. After all, we all start as a fertilized ovum whose behavior gives no evidence of awareness. Unless we believe that an entity like a "soul" or "mind" is somehow inserted into the human embryo from outside at some stage, we must conclude that this capacity for subjective awareness arises naturally and gradually in the course of development out of some dim original potentiality.

In this connection an analogy with bioelectricity is useful. As any zoologist knows, there are several genera of electric fish. Some are capable of giving quite severe shocks, while others, which are inhabitants of muddy waters where vision is not of much use, emit electric pulses by means of which they detect objects at a distance and so can steer themselves. (In passing, it is interesting that Galen mentions that electro-shock treatment was employed in antiquity — torpedo fish were used as a cure for headache and various other disorders.) A century ago, the electrical properties of these fish were supposed to be unique, and the problem of their evolutionary origin was a great puzzle to Darwin. However, we now know that the activities of every living cell in the body are accompanied by minute electrical changes: such changes occur every time a gland secretes or a muscle contracts. These are accidental epiphenomena, in the sense that they are not of direct biological advantage to the organism, but are merely consequences of the way living substance is made. In electric fish, on the other hand, certain tissues (muscular in some cases, glandular in others), have been modified so as to amplify and summate these minute electrical changes until they reach an intensity which is of biological significance.

This provides a perfectly good analogy with the evolution of mind. In this view, every living organism has what I may call a "mentoid" or potentially mental aspect, something of the nature of subjective awareness which is merely a consequence of the way it is made, and confers no biological advantage in its life. Brains, on the other hand, are organs where a large number of impulses from many different kinds of sense-organs, extero-, intero-, and proprioceptive, are brought together in some kind of closed-circuit system and can interact and combine there without issuing directly in motor activity, as with reflex systems. Brains are thus a mechanism for

intensifying, amplifying and organizing life's original dim subjectivity to a level where it becomes significant in the life of the organism.

Today, we can be certain that biological evolution has taken place primarily, and indeed almost wholly, by means of the mechanism of natural selection. This means that no important character can evolve unless it is of biological advantage. This being so, mind cannot be just a useless epiphenomenon; it must be of significance and confer biological advantage. It does so by giving the organism a fuller awareness of both outer and inner situations, thus providing better guidance for behavior in the chaos and complexity of existence.

One way in which it does this is that, in some unexplained way, it generates qualitative distinction out of quantitative difference. The sensation of blue is irreducibly different from red. The difference between blue and red depends on quantitative differences in the frequency of the light-waves reaching the retina and of the impulses passing up the optic nerves, but, as sensations, blueness and redness are qualitatively distinct. Biologically, this permits readier discrimination between objects: it is much easier to discriminate between two qualitatively different colors than between two quantitatively different shades of gray.

Discrimination is similarly aided by the radical qualitative differences between the different modalities of sensation — sight, hearing, touch, smell, and so on — which again are irreducible in terms of any common factor. Again, it is essential to be able to discriminate potentially damaging situations and objects from those which are potentially enjoyable and useful, and this has been achieved through the radical qualitative difference between the sensations of pleasure and of pain. Similarly, it is valuable to discriminate between threatening or dangerous situations and desirable or useful ones: this has been achieved by the evolution of sharp quantitative differences in our "built-in" emotions — fear as against curiosity, for example, or sexual attraction as against hostility.

Finally, the central organ of awareness, the brain, has the astonishing capacity of integrating an enormous number of separate, and often disparate, elements of experience into an organized pattern of which the animal is aware as a whole, and which it experiences as different from all other such patterns. One of the ways in which experience is integrated is in memory; another way is in mental organizations for directing future behavior.

This integration of sensory information into organized patterns which can be readily discriminated in awareness may produce extraordinary results. Some of the most extraordinary are concerned with the way in which animals find their way about. For instance, we now know that migrating birds find their way by steering with the sun if they are day migrants and by the constellations if they are night migrants. Of course, they can only do this by means of some extremely elaborate computer system in their brains — though this is no more elaborate than the computer system in our own brains which enables us, while playing tennis, to anticipate our opponent's stroke with appropriate movements of our own. In both cases, however, the computer system is only the mechanism of the action; the organism must in some way be aware of the situation as a whole in order to put the computer system into operation. This instantaneous awareness of total situations is a psychometabolic activity of decisive importance for successful behavior.

Many interesting psychometabolic organizations operate in higher animals. Frequently, learning capacity is grafted onto an innate response. A good example is found in the English Robin, which is quite different from the American Robin, a smaller bird with a brighter red breast. In the breeding season, the sight of a red-breasted rival will stimulate hostility in a male Robin in occupancy of a territory. The same effect is produced by a stuffed dummy; even if the dummy's head, tail and wings are removed, leaving only a fragment of body with a patch of red feathers, this will be attacked in the same way. The sight of the red breast is a simple sign-stimulus which releases a built-in mechanism of attack. On the other hand, the system can be modified by the further psychometabolic activity of learning. A male Robin will learn to accept a female as mate even though she too has a red breast; and eventually, through becoming aware of slight differences in behavior, he will learn to discriminate between his individual mate and other female Robins, though they are indistinguishable to the human observer.

Just as the evolution of new kinds of material metabolism can provide the material basis for further biological change, so the evolution of new kinds or modes of awareness has effects on later evolution. Let me again take color and pattern as an example. As soon as there were organisms which came into existence possessing the capacity for colored pattern-vision, new and adaptive patterns began to evolve, both in members of the same species and in other

species. Such characters are called allaesthetic; they have evolved in relation to the sensory capacity of other organisms. Patterns of warning coloration in insects, for instance, could not have evolved except in relation to the color-vision of the predators of the insects; and the striking color-patterns seen in the sexual display of birds could not have evolved unless birds were capable of color-vision and pattern-discrimination. Striking examples of allaesthetic characters are found in flower-color. Bees are completely red-blind, but they can see ultraviolet. In consequence, there is a total absence of pure scarlet flowers pollinated by bees. Some pure scarlet flowers exist, but they are all pollinated by birds, because birds can see red. Conversely, if bee-pollinated flowers are photographed by ultraviolet light, patterns are often revealed which are invisible to our eyes, but are of functional importance in guiding the bees to the nectar: they have been evolved in relation to this capacity of bees to see ultra-violet.

Let me return to the simple visual patterns serving to release specific behavior, which have come into prominence through the work of men like Lorenz and Tinbergen and Thorpe. The newly hatched Herring-gull pecks at its parent's bill, which then regurgitates food for it. Tinbergen showed that if the newly hatched young is tested before it has even seen an adult bird, it will peck just as well at a colored cardboard model as at the real parent's beak. The pattern of the beak — yellow with a red spot at the tip of the lower mandible — acts as a sign-stimulus operating the mechanism releasing the pecking reaction.

The whole system is "innate" — genetically determined. But its operation can be modified. As mentioned earlier, the normal beak is yellow, fairly elongated and with a red spot near the end of the lower mandible. A model without any spot has very little effect on the young. One with a spot of another color than red will be less efficient than the normal pattern, but more so than a model without any spot. Shortening the beak will make the model less effective, while a model which is not in the least like a normal beak, but is a very elongated rectangle with a very bright red spot near its end, will elicit a *supernormal* response — it will induce the young to peck at it more vigorously than they will at their own parent's beak.

We find similar phenomena in human beings. Here again, we find allaesthetic characters. In the evolution of man, both color and form have been employed as sign-stimuli, releasing sexual behavior

or at least promoting sexual attraction. The red color of lips and cheeks is obviously of value in sexual selection, and its supernormal enhancement by rouge and lipstick is the basis for a large portion of the lucrative cosmetics industry. The form of the female breast is also a sexual sign-stimulus: its enhancement is the basis for the manufacture of brassieres, and its supernormal exaggeration has given rise to the article known as "falsies."

Ethology, as the study of animal behavior is now called, has led to some illuminating facts about the results of conflict situations. If a bird's aggressive impulses are stimulated by the presence of a rival, it often shows what is called an "intention movement" before it actually starts fighting — it gets itself into readiness for fighting. Similarly, if it is frightened, but before it actually flies off, it often shows an "intention movement" preparatory to flight. Sometimes a situation occurs in which two such emotional forces or drives are opposed in conflict. For instance, early in the breeding season, when the birds begin to mate up, the close proximity of another individual still elicits a certain amount of hostility and/or fear. Accordingly the male bird, as he approaches the female, is simultaneously animated by sexual attraction, hostility and fear. The result is a compromise attitude, intermediate between the intention movements of approach and of fleeing. Since such compromise attitudes are a regular feature of sexual approach in early breeding season, they have been utilized and polished up (if I may speak metaphorically) by natural selection and turned into functional sign-stimuli, which release sexual behavior-patterns in the mate. Attitudes which originate as mere consequences of a conflict become ritualized and converted into something of biological importance in their own right.

Another surprising consequence of conflict is what ethologists call "displacement activity." Apparently, when two conflicting drives are operating at high intensity, instead of just canceling each other out, the excess nervous tension (if I may again speak metaphorically) spills over into some quite irrelevant activity. In bird courtship, the frequent conflict between hostility and fear, instead of leading to a compromise attitude, may spill over into so-called displacement preening: the birds "make as if" to preen themselves, but do not really do so. Here again, actions which start as mere consequences may be seized on by natural selection and converted into functional sign-stimuli. Thus the displacement preening attitude of many species of

duck has been exaggerated, and the parts of the plumage to which it is directed have come to be adorned with bright colors, so that it has come to play a significant role as a releaser of mating behavior.

As Tinbergen and Lorenz have shown, these facts have relevance for man. Human beings show many displacement activities, such as scratching their heads when puzzled. More basically, conflict and the reconciliation of conflict in meaningful activity are of fundamental importance in human mental development, and are one of the chief concerns of psychiatrists. In man, instead of conflicting drives resulting in overt compromise attitudes, they often continue to operate internally. This results in a conflict of what we may call "intention urges" — urges or drives toward aggression, or fear, or sexual attraction; but whatever the conflict is based on, it is not overtly manifested in action. The problem is this: can these conflicting urges be reconciled internally and converted into something which combines the energy of both drives in a single and functionally valuable "superdrive"? Or are their energies going to remain locked up, so to speak, in functionally useless conflict? Or is half the energy of the conflicting drives going to be wasted by the repression of one of them?

In man there are very few examples of built-in sign-stimuli acting as releasers. The best-known is the so-called smile reflex of the human infant, which Spitz and others have studied. Even a crude model of a smiling human face will elicit a smile from the human infant at a certain early stage of life. Later, this becomes a more sophisticated reaction: learning enters in and you have to have a real face with a real smile, or at least a reasonable representation of them. The interesting thing about the smile reaction is that it is a self-reinforcing process. When the infant smiles at the mother, even if she is not smiling, she will smile back in return, and vice versa. The self-reinforcing process establishes and helps to strengthen the emotional bond between mother and infant.

This establishment of emotional bonds between members of a species is obviously of the greatest importance in evolution. Once again there are traces of it in sub-human creatures. My first important piece of behavior study was on the courtship behavior of a British bird, the Great Crested Grebe. In this species, both sexes develop elaborate sexual adornments in the breeding season and employ them in mutual displays. It is quite clear that, in addition to their stimulative function, these displays serve as an emotional bond

between the members of the pair. They serve to keep the pair associated throughout the whole season, during which the young need to be looked after by both parents.

The bases of such emotional bonds are sometimes very interesting. In his fascinating studies of monkeys, Professor Harlow of Wisconsin took new-born monkeys away from their real mothers and gave them pairs of surrogate mothers. Both possessed an iron framework and a crude model of a face; one of them, the feeding mother, was provided with a bottle of milk which was the baby monkey's only source of food; the other, or furry mother, merely was covered with a furry material. In contradiction to psychoanalytic theory, the baby monkey chose to spend much more time with the furry mother, who did not satisfy its hunger but gave it a feeling of protection and an agreeable tactile sensation. It will be extremely interesting to see what happens to these monkeys after they have been brought up entirely by artificial mother surrogates. Can they be made to reaffirm an emotional bond with a real female monkey or a human surrogate? [2]

Besides bonds between members of a mated pair, and those between parent and offspring, there are familial bonds and the extremely interesting social bonds that operate in organized animal societies. Konrad Lorenz's delightful and important book, *King Solomon's Ring,* gives an account of some of these. I have only time to mention one, but one which is of great interest. The wolf-pack is an organized society of proverbially aggressive animals, but when a bigger or higher-ranking wolf is quarreling with a smaller or younger one, and the smaller one feels that he is in danger of being beaten and hurt, he will adopt a special "appeasement attitude," deliberately displaying his most vulnerable part. This acts as a sign-stimulus which definitely inhibits further aggressive behavior on the part of the larger wolf, or, if you prefer, releases a non-aggressive pattern of behavior. However angry he may have been, he just finds himself unable to go on attacking the smaller animal which is advertising its defenselessness. An ethologist friend of mine has applied this fact to human situations. He has twice recently avoided punishment for motoring offenses by assuming a cringing self-deprecatory "appeasement attitude." In one case an aggrieved car-owner didn't even take his name and address; in the other a policeman wouldn't give him a ticket. I recommend this as a very useful piece of applied psychology, but it needs histrionic skill.

Finally there are the bonds between generations. These become of increasing importance in higher vertebrates. In some birds and mammals we see the beginnings of what one must call tradition, the handing down of the results of experience from one generation to the next. Originally this occurs only across a gap of one generation: thus among many carnivores, like foxes and lions, the young learn hunting from their parents, usually from the mother. But in the case of the Japanese monkey, we see the beginnings of cumulative tradition. The animals go about in large troops and each troop has its own food-tradition (as well as its own type of social structure): different troops have slightly different ranges of foods. Occasionally there will be an innovation. In one case young monkeys were what we call in human terms "naughty" and persisted in eating a forbidden food, even when their elders tried to stop them. Eventually the new habit spread to other juveniles, then to their mothers, then to the dominant males, and finally to the subdominant males: the process took over three years. In another case a new food habit (eating wheat) was begun by the dominant male, and then spread rapidly to females and juveniles. This is the real beginning of culture in the anthropological sense, based on the cumulative transmission of experience, including some novel experiments.

Then there are many examples of normally unrealized possibilities, cases where evolution has produced organizations which possess potentialities that are not actually realized in the normal life of the species. One of the best known cases is the counting ability of birds. Professor Otto Koehler, in Germany, found that Jackdaws have just as good a capacity for non-verbal counting as human beings. They can distinguish between sets of objects according to their number alone, up to seven, which is the limit of non-verbal counting for most humans. Of course, if we employ verbal counting — 1 - 2 - 3 - 4 - 5 - 6 and so on — we can distinguish very large numbers; but without it we cannot do any better than Jackdaws. Yet, as far as we know, this ability to count non-verbally up to seven is not utilized by Jackdaws in nature.

Another example comes from a species of titmouse, *Parus coeruleus*, the Blue Tit. In England and Western Europe after the last war there was a veritable epidemic of milk-bottle opening by these birds, pecking off the cardboard lids and drinking the cream. This was something no Blue Tit had ever done before.

In this case, individual variation was also involved. Careful

analysis showed that the habit had spread from three separate foci: there must have been three individual tit geniuses who discovered how to open milk-bottles, and the practice spread by some form of imitation or learning.

The amount of individual variability is quite high in all higher vertebrates and may be of decisive importance for the success of the species. Thus, in the Blue Tit, this valuable habit was originated by a handful of exceptional individuals. Distinctive individual variability also occurs, but in a rather different context, in Bowerbirds. Bowerbirds are of extreme interest because they show the beginning of aesthetic preference. For instance, Satin Bowerbirds not only prefer blue objects to put in front of their bowers, but reject red ones and remove them to a distance. In subjective terms, they dislike red and prefer blue. Not only that, but the males will deliberately paint the bases of the twigs composing their bowers with a mixture of berry juices and charcoal chewed up in their mouths, using a stick in their beak as a kind of brush. However, only a minority of the males do this, and still fewer individuals have learned to indulge their preference for blue objects by stealing blue bags from human houses.

The realization of such latent possibilities depends on environmental conditions. As we have just seen, man has no greater capacity for non-verbal mathematics than a Jackdaw. But in modern societies, with the aid of symbolic language and proper training, many men have the capacity for higher mathematics, although this could not have been any use to primitive man when he first evolved.

Let me take a very different example. When I was in Africa two years ago, I had the good fortune to see the famous lioness, Elsa, which Mrs. Adamson brought up and then released into the wild, where she had mated with a wild lion and produced three cubs. It was really extraordinary to see how something that one must call a human-like personality had been elicited by love and interest and devoted care from this wild and aggressive creature.

Unused potentialities are often implicit in the motor structures of animals. It is on the basis of their unrivaled manipulative abilities that chimpanzees and human beings are so intelligent. The same applies to elephants. They too are exceptionally intelligent, and can manipulate objects almost as delicately as can apes or human beings. Since they do this with trunks instead of hands, I propose to call

their ability *trombipulative* (I am sure that Dr. Johnson would have approved the term). But whatever we call it, it is on the basis of this ability that they have become so extremely intelligent and have developed such an elaborate social life.

(One elephantine incident, though irrelevant to my present argument, will I think interest this psychiatric gathering. When my wife and I were in the Murchison Falls Park in Uganda, the Warden told us that some months earlier he had heard an unusual type of excited screaming by an elephant. He came around a corner to find a middle-aged elephant bull approaching a younger male with homosexual intentions. The younger male was rejecting these improper advances; eventually the older bull became so frustrated that he lay on his back, rolled on the ground, and trumpeted. The younger male thereupon sat down on his haunches and just looked at the other; upon which the Warden laughed so loud that both the elephants took fright and ran off!)

Thus, if I may sum up my argument, during the biological evolution of animals, the upper level of organization of awareness has been steadily raised. This has led to a steady increase in the extent and elaboration of what we may call the animal's significant world, that part of the universe which has meaning for the organism. Think of the difference between the significant worlds of an amoeba and a flatworm, of a flatworm and a fish, of a fish and a higher mammal, of a higher mammal and ourselves.

THIS BRINGS ME TO MY REAL SUBJECT. Throughout evolution, the animal, with the aid of various bodily organs, utilizes the raw materials of its food, drink, and inspired air and transforms them into characteristic biochemical patterns which canalize and direct its physiological activities. This is metabolism. But with the aid of its brain, its organ of awareness or mind, it utilizes the raw material of its subjective experience and transforms it into characteristic patterns of awareness which then canalize and help to direct its behavior. This I venture to call psychometabolism.

During the latter stages of evolution, an increasingly efficient type of psychometabolism is superposed on and added to the universal physiological metabolism. Eventually, about 10 million years ago, purely biological evolution reached a limit, and the breakthrough to new advance was only brought about by the further elaboration of the psychometabolic apparatus of mind and brain. This gave rise

to man: it endowed him with a second method of heredity based on the transmission of experience, and launched him on a new phase of evolution operating by cumulative tradition based on ideas and knowledge. Both novelties are of course superposed on the biological methods of transmission and evolution, which he also possesses.

In man, organizations of awareness become part of the evolutionary process by being incorporated in cultural tradition. Accordingly, in human evolution totally new kinds of organization are produced: organizations such as works of art, moral codes, scientific ideas, legal systems, and religions. We men are better able to evaluate, to comprehend, to grasp far more complex total patterns and situations than any other organism. We are capable of many things that no other animal is capable of: conscious reflection, the idea of self, of death, and of the future in general; we have the capacity of framing conscious purposes which can then be translated into action, and of constructing values as norms for our activities. The result is that evolution in the psychosocial phase is primarily cultural and only to a minor extent genetic.

Of course all these new types of organization evolve like everything else. The science of comparative religion shows how religions have evolved and are still evolving. The history of science studies the evolution of scientific ideas and how they become operative in the psychosocial process.

Our mental or psychometabolic organizations fall into two main categories: those for dealing with the outer world and establishing a relation with external objects; and those for dealing with our inner world and relating our perceptions and concepts and emotional drives to each other and integrating them into a more or less harmonious whole. The ultimate aim is to deal with all kinds of conflict and to reduce mental friction, so as to get the maximum flow of what is often called mental energy.

Here I want to put in a plea against the physicists' bad semantic habit of appropriating terms from common human usage and restricting their employment to physicochemical phenomena. In the strict physicist view, it is no longer permissible for a biologist to use the term "mental energy"; for the physicists, energy is something exclusively material and mathematically definable in terms of mass, velocity and the like. But the biologist and the psychologist also need a terminology. There *is* something operating in the awareness-

organization of man and higher animals which is analogous to energy in the physical sense, and can operate with different degrees of intensity. For this, we may perhaps use the term *psychergy*, without committing ourselves to any views as to its precise nature.

A major job for all disciplines concerned with human affairs, whether biochemistry, psychology, psychiatry or social anthropology, is to investigate the extraordinary mechanisms underlying the organization and operation of awareness, so as to lay the foundation for and promote the realization of more meaningful and more effective possibilities in the psycho-social process of human evolution.

When we look at animal behavior, it is clear that differences in possibilities of awareness between different species are primarily genetic. One species of bird prefers blue, another does not: the sign-stimulus which will release adaptive patterns of action in one species of bird, will not do so in another. There is obviously a genetic basis for the difference.

Equally obviously, there is a genetic basis for the difference between the genetically exceptional individual and the bulk of the species. All great advances in human history are due to the thought or action of a few exceptional individuals, though they take effect through the mass of people and in relation to the general social background. We have seen how, already in birds and mammals, the exceptional individual can be of some importance in the life of the species. In man, the exceptional individual can be of decisive importance.

Today, many workers in psychology and psychiatry and other behavioral and social sciences resist or even deny the idea that genetic factors are important for behavior. I am sure that they are wrong. Of course environmental factors, including learning, are always operative, but so are genetic factors. To take an example, genetic differences in psychosomatic organization and somatotype are obviously correlated with differences in temperament, and these with different reactions to stress and proneness to different diseases.

Frequently, it is not so much complete genetic determination we have got to think about, but rather proneness to this or that reaction, a tendency to develop in this or that way. This comes out very clearly in regard to cancer: every different inbred strain of mice has a different degree of proneness for a different type of cancer — sometimes 40%, sometimes 80%, in a few cases 100%. Professor Roger Wil-

liams of Texas has coined a new word, *propetology*, to denote genetic proneness. A science of propetology is badly needed.

The old-fashioned behaviorists simply denied any influence to genetic factors. For them everything was due to learning; and I am afraid that a number of ethologists and students of behavior, especially in America, still stick to that point of view. They forget that even the *capacity* to learn, to learn at all, to learn at a definite time, to learn one kind of thing rather than another, to learn more or less quickly, must have some genetic basis.

One of the most curious discoveries of the past 30 or 40 years has been that of the sensory morphisms, where a considerable proportion of the population has a sensory awareness different from that of the "normal" majority. The best known cause is a taste-morphism. Phenylthiocarbamide (PTC) tastes very bitter to the majority of human beings, but a minority of about 25%, varying somewhat in different ethnic groups, cannot taste it at all except in exceedingly high concentrations. As R. A. Fisher pointed out in his great book, *The Genetical Basis of Natural Selection*, in 1930, two sharply contrasted genetic characters like this cannot coexist indefinitely in a population unless there is a balance of biological advantage and disadvantage between them. Thus whenever we find such balanced polymorphisms, or *morphisms* as they are more simply called, we know that there must be some selective balance involved. Quite recently it has been shown that PTC taste-morphism is correlated with thyroid function; here we begin to get some inkling of what advantage or disadvantage there may be.

Years ago, Fisher, Ford, and I tested all the captive chimpanzees in England for PTC sensitivity. We found, to our delight, that within the limits of statistical error they had the same proportion of non-tasters as human beings. People asked, "How did you find out?" Actually it was quite simple; we offered them a sugar solution containing PTC. If they were non-tasters, they drank it up and put the cup out for more; if they were tasters, they spat it in our faces: it was an all-or-nothing reaction. The fact that both chimpanzees and man react alike means that this balanced morphism must have been in existence in the higher primates for at least 10 million years.

There are a number of these sensory morphisms in man. There is a sex-linked morphism with regard to the smell of hydrogen cyanide, HCN; about 18% of males are insensitive to it, which can

be dangerous in a chemical works or laboratory. There is another smell-blindness with regard to the scent of Freesias. I personally am one of the considerable minority of human beings unable to smell Freesias; I can smell any other flower, but am absolutely insensitive to the particular smell of even the most fragrant Freesias. There are visual morphisms; the best known is red-green color-blindness, which is also sex-linked. Another appears to be myopia. I remember years ago discussing with Professor H. J. Muller the puzzling fact of the considerable incidence of apparently genetic myopia in modern populations. However, he pointed out that during a considerable period of human history, from the time when people began doing fine, close work and up to the period when spectacles were invented, myopia would confer certain advantages. The short-sighted man would not only be employed on well-paid work, but would usually not be sent to war, so that there was less likelihood of his being killed. This would balance the obvious disadvantage of myopia in other aspects of life.

There are some very interesting biological problems concerning sensitivity to pain. Some human mutants are apparently insensitive to pain altogether and may incur terrible injuries because damaging agencies do not hurt them; but these are very rare. On the other hand, giraffes have mouth-cavities and tongues which appear to be surprisingly insensitive to pain. I always thought that they used their beautiful long tongues to strip the leaves off the extremely thorny acacia trees on which they often feed without getting pricked; but apparently this is not so. Recently in the London Zoo, giraffes have been tested with spiny hawthorn branches: they accept them and chew them just as readily as soft foliage. This surprising fact is worth further investigation.

AT THE OTHER END of the psychometabolic scale from sensation, we have problems like schizophrenia. Apparently this too must involve a balanced morphism. First, in all countries and races there are about 1% of schizophrenic people; secondly, the disease appears to have a strong genetic basis; and thirdly, as already mentioned, genetic theory makes it plain that a clearly disadvantageous genetic character like this cannot persist in this frequency in a population unless it is balanced by some compensating advantage. In this case it appears that the advantage is that schizophrenic individuals are considerably less sensitive than normal persons to histamine, are much

less prone to suffer from operative and wound shock, and do not suffer nearly so much from various allergies. Meanwhile, there are indications that some chemical substance, apparently something like adrenochrome or adrenolutin, is the genetically-determined basis for schizophrenia, and in any case there is a chromatographically detectable so-called "mauve-factor" in the urine of schizophrenics.

This biochemical abnormality presumably causes the abnormality of perception found in schizophrenics. The way the schizophrenic psychometabolizes his sensory experience and relates his sensations to build meaningful perceptions, is disordered. Accordingly he is subject to disorders of sensation and of all sorts of perception, including disorders of perception of time and space, and of association. Apparently, schizophrenic individuals show much less consistency in association tests than do normal people. The schizophrenic's world is neither consistently meaningful nor stable: this naturally puts him out of joint with his fellow human beings and makes communication with them difficult and frustrating, so that he retires much more into his own private world.

Hallucinogens like mescaline, lysergic acid, and psilocybin (from a Mexican fungus) appear to exert similar dislocating effects on perception, even in incredibly low doses. In addition, they can produce totally new types of experience: some of their effects can elicit something quite new from the human mind. They may have unpleasant effects if the subject is in a wrong psychological state, and exceedingly pleasant and rewarding effects if he is in a right one. But in either case they may reveal possibilities of experience which the subject did not know existed at all. For this reason the term *psychedelic*, or mind-revealing, has been suggested for this type of psychotropic drug. In many ways their effect closely resembles a very brief but acute schizophrenia: perception is disordered in a way very like that seen in schizophrenic patients.

In psychedelic drugs we have a remarkable opportunity for interesting research. Nobody, so far as I know, has done any work on their effects on different types of psychologically normal people — people of high and low IQ, of different somatotypes, of different affective dispositions, on verbalizers and visualizers. This would be of extraordinary interest: we might find out not merely how to cure some defect, but how to promote creativity by enhancing the creative imagination.

Another problem is to discover whether psychedelics modify or enhance dreaming. The study of dreaming has received a great impetus since the recent discovery that dreaming is necessary for good mental health. If people are prevented from dreaming night after night, their mental health begins to suffer. Dreaming, it seems, provides a satisfactory way of psychometabolizing various facts and experiences that have proved resistant to the integrating efforts of our waking psychometabolic activity. Unconscious mechanisms take revenge and provide an outlet in dreams.

Early detection is another facet of the schizophrenia problem. Here too, study and research are obviously needed. Granted that there is a genetic proneness to schizophrenia, it should be possible in many cases to detect its symptoms in quite early stages of life. This could clearly best be done in the schools, so that it will be important to establish a close link between psychiatrists and school teachers. The teachers would pick out the children who are prone to schizophrenia; while the psychiatrists would then suggest appropriate methods of education and training to prevent the disease from developing.

Indeed, the subject of education in general clearly needs overhauling, in the light of the two views of the human organism that I have been advocating. Today, we have hardly begun to think of how to educate the organism as a whole — the mind-body, the joint psychophysiological mechanism which we call the human child. We confine ourselves almost entirely to mental education through verbal means, with the crude physical education of games and physical training added as something quite separate. As my brother Aldous has stressed, we need non-verbal education as well, and education of the entire mind-body instead of "mind" and "body" separately.

It is not only in regard to schizophrenia that we are confronted with situations which demand immediate remedial measures, but later find ourselves impelled to adopt a preventive or a constructive attitude. Medical history is largely the story of people trying to cope with disease, then attempting to prevent disease from arising, and finally turning their knowledge to good account in the promotion of positive health. The same is true of the psychological approach. The psychiatrist starts with the mentally diseased person, tries to cure him, or at least to prevent his disease developing further, but in the course of this remedial process, he acquires knowledge which can be of extreme importance in building up a more fruitful normal personality. However, to achieve this, a new approach is needed. Psychiatry usually attempts to analyze the causes of the diseased condition and discover its origins. The very term *psychoanalysis* commits the Freudian practitioner to this approach. This is important, but is certainly not sufficient. All important biological phenomena are irreversible processes, whose end-results are biologically more significant than their origins. Accordingly, we must study the whole process, its end-results as well as its origins, its total pattern as well as its elements.

In psychology, pure and applied, medical and educational, our main aim should be to discover how to regulate the processes of psychometabolism so that they integrate experience in a more effective and less wasteful way and produce a more fruitful end-organization. For instance, I am sure that a study of the origin and strengthening of emotional bonds will repay a great deal of effort. Let me take John Bowlby's work as an example. He studied the development of children who had been deprived of maternal care (including care by a mother substitute) during a critical period of early life, and therefore were unable to form the primary affectional bond between infant and parent. Such children proved incapable of forming further emotional bonds and of developing a normal affectional and moral organization. This whole problem of building up affectional bonds, whether between members of a family or a social group, is fundamental for human life.

The overriding psychometabolic problem, of course, is how the developing human being can integrate his interior life, whether by reconciling emotional or intellectual conflict in a higher synthesis, or by reconciling diversity in a more embracing unity. Let me take the creative arts as an example. Thus the poet must reconcile diverse and even conflicting meanings in a single work of art and, indeed, must employ multivalent or multi-significant words and phrases in the process. Good poems and paintings are among the highest products of man's psychometabolic activities. Milton's line, "Then feed on thoughts that voluntary move harmonious numbers . . ." beautifully expresses this psychometabolic concept of artistic creation, while Lowe's celebrated critical study, *The Road to Xanadu*, shows how Coleridge psychometabolized the raw materials of his personal experience, his reading and his conversations and discussions, and was able to integrate them into a single poem, "Kubla Khan," with amazing emotional impact.

As an example of the emotional impact exercised by great art, let me recall a story of Bertrand Russell. When he was an undergraduate at Cambridge, he and a friend were going up his staircase in College and the friend quoted Blake's famous poem, "Tiger, Tiger!, Burning Bright." Bertrand Russell had never heard or read this before, and was so overcome that he had to lean against the wall to prevent himself falling.

On the other hand, we all know that many poems and works of art fail sadly to achieve this desirable result. The way in which an operatively effective unitary pattern of intellectual, emotional and moral elements can be built up, certainly deserves study, not merely in art, but also in morality, religion, and love.

Mysticism is another psychometabolic activity which needs much further research. A really scientific study of the great mystics of the past, of their modern successors, of Yoga and other similar movements, undoubtedly would be of great value. The scientist need not, indeed must not, accept at their face value the claims of mysticism, for instance, of achieving union with God or the Absolute. But some mystics have certainly obtained results of great value and importance: they have been able to achieve an interior state of peace and strength which combines profound tranquillity and high psychological energy.

There is also the still much neglected subject of hypnotism and hypnosis, with all its implications. One of the darker chapters in the history of science and medicine is the way in which the pioneer hypnotists were attacked and often hounded out of the medical profession. Even today, there is still clearly a great deal to be discovered in this strange and exciting subject.

The field of the psychiatrist and the psychologist today is nothing less than the comprehensive study of hypnosis, drugs, education, mysticism, and the subconscious, of mental disease and mental health, of the relation between normal and abnormal or supernormal experience. Backed by the concept of psychometabolism and the fact of the increasing importance of psychological organization of experience during evolution, they will be working for a better integration of all the psychological forces operating in man's life — emotional, imaginative, intellectual and moral — in such a way as to minimize conflict and to maximize creativity. In so doing, they will be in harmony with the only desirable direction that our scientific vision

indicates for the future evolution of man — a direction making for increased fulfillment of individual human beings and fuller achievemen by human societies.

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[1] 31 Pond Street, Hampstead N.W. 3, London, England. Reprinted, with permission of author and publisher, from *Journal of Neuropsychiatry*, Vol. 3, Supplement No. 1, August, 1962. (Special Supplement: Symposium, "Newer Psychotropic Drugs and Human Behavior," San Francisco, April 28-29, 1962.)

[2] I have later learned that such monkeys suffer irreversible emotional damage and grow up permanently abnormal. Something of the sort occurs with the human babies, deprived of adequate maternal love and care during a critical period of their infancy, as John Bowlby has shown.

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The Treatment of Alcoholism With Psychedelics

The recent discovery and application of psychedelic substances such as psilocybin, LSD, and mescaline in the treatment of chronic alcoholics represent a promising new approach to this major social problem. Four studies on the treatment of alcoholics with psychedelics will be reported and summarized (1, 2, 3, 4). All of these studies were conducted in Saskatchewan, Canada, in various hospital settings and by different researchers using reasonably good controls and follow-up methods.

The patient-populations in these studies varied somewhat among each other in terms of different psychopathological diagnostic categories. Typically, only the most difficult cases of chronic alcoholism were selected for study and treatment with psychedelics — patients who had undergone various forms of treatment over the years, including membership in Alcoholics Anonymous, without benefit.

The procedure employed in these studies generally used a single massive dose (200-1500 μg) of LSD in one treatment session. (In one of the studies the patients had the option of further sessions, if needed.) The patients were prepared for the ingestion of the psychedelics through individual psychiatric screening, medical examination and individual and group discussions about the nature of the drug experience. The period of preparation varied from study to study, lasting from two days to two weeks.

The patients spent the day of the "session," or drug treatment, in the hospital where the drugs were administered. The physical setting was carefully prepared to give the patients a sense of esthetic enjoyment. The drugs were administered to each patient individually, with trained personnel and one of the researchers in attendance. All