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# ON CREATIVITY\*

D. Bohm\*\*

**Abstract**—Creativity cannot be defined in words, but one can perhaps at least begin to indicate what it is in an oblique and indirect way, by asking why scientists are so deeply interested in their work. By eliminating many of the generally accepted but superficial answers to these questions, one soon discovers that a scientist is seeking to learn something different from what can be inferred from previous knowledge, something leading ultimately to a new perception of the wholeness, beauty and harmony in the order and structure of natural process. Such a perception is akin to what is sought, although in a very different way, by the artist, the musician, the architect, and indeed by all who are engaged in truly creative action.

Nevertheless, it is necessary to be more precise about what is meant by the notion of creativity. What is order? What is structure? What is process? In this article, these questions are considered, and certain answers are suggested, at least in a provisional way. The meanings of these suggestions are brought out in several examples, drawn mainly from the actual history of the development of science, but not entirely restricted to this field.

The question is then raised as to what is preventing the vast majority of human beings from being really creative, except perhaps on rather rare occasions. Further discussion suggests that in a way, the creative possibilities of the mind are generally dormant. This state of 'sleep' is probably the result of a very widespread and deep confusion between the creative and the mechanical. As a result of this confusion it is very hard even to perceive that one is not creative.

The essay concludes with a brief discussion of what it would mean to be free of this confusion, and how such freedom might perhaps come into being.

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Creativity is, in my view, something that it is impossible to define in words. How then can we talk about it? Words can indicate or point to something in the minds of the readers that may be similar to what is in the mind of the writer. I would like, thus, to indicate to the reader what creativity means to me. If you will read in this spirit, you can then see whether, and to what extent my notions make sense to you.

I am a scientist. I shall, therefore, try to begin in this field and extend out to others.

The basic question that I should like to consider is this:

Why are scientists in many cases so deeply interested in their work?

Is it *merely* because it is useful? It is only necessary to talk to such scientists to discover that the utilitarian possibilities of their work are generally of secondary interest to them. Something else is primary. What is it?

Could it be that a scientist deeply wants to dis-

cover the laws of nature, so that he can *predict* natural phenomena, and thus enable man to participate intelligently in nature's processes so as to produce results that he desires? Of course, such prediction and intelligent participation can some times be very interesting. But this is only in a context in which these activities are determined by something else that is more deeply significant, such as, for example, a common goal of great importance. Generally speaking, however, there is hardly ever such a common goal. Indeed, in most cases, the content of what the research scientist predicts is *in itself* actually rather trivial (e.g. the precise paths of particles, the precise number of instruments that will register a certain phenomenon, etc.). Unless there were something beyond this that could give it significance, this activity would be petty and indeed even childish.

Is it then that the scientist likes to solve puzzles? Does he want to get a 'kick' out of meeting the challenge of *explaining* a natural process, i.e. showing how it works?

Of course, a scientist may often find this aspect of his work very enjoyable. Nevertheless, such enjoyment has properly to come as a *by-product*

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of something else that goes much deeper than this. Indeed, if a scientist worked *mainly* in order to get hold of such pleasures and continue them as long as possible, his activity would not only be rather meaningless and trivial, but also contrary to what is needed for carrying out his research effectively. For the recognition that one's ideas are false or on the wrong track (which is often crucial for making real progress) generally gives rise to extremely unpleasant feelings of disappointment and failure; and to avoid these, the scientist whose *first* aim was pleasure would tend to overlook weak points in his work (as indeed does unfortunately tend to happen with surprising frequency).

It seems then that the answer to the question of why the scientists are so deeply interested in their work is not to be found on such a superficial level. Scientists are seeking something that is much more significant to them than pleasure. One aspect of what this something might be can be indicated by noting that the search is ultimately aimed at the discovery of something *new* that had previously been *unknown*. But of course, it is not merely the novel *experience* of working on something different and out of the ordinary that the scientist wants. (This would indeed be little more than another kind of 'kick'). Rather, what he is really seeking is to learn something new that has a certain fundamental kind of significance: i.e. a hitherto unknown lawfulness in the order of nature, which exhibits *unity* in a *broad range* of phenomena. Thus, he wishes to find in the reality in which he lives a certain oneness and totality, or wholeness, constituting a kind of *harmony* that is felt to be beautiful.

In this respect, the scientist is perhaps not basically different from the artist, the architect, the musical composer, etc., who all want to *create* this sort of thing in their work.

To be sure, the scientist emphasizes the aspect of *discovering* oneness and totality in nature. For this reason, the fact that his work can also be creative is often overlooked. But in order to discover oneness and totality, the scientist has to create the new overall structures of ideas, which are needed to express the harmony and beauty that can be found in nature. Likewise, he has to create the sensitive instruments, which aid perception and thus make possible both the testing of new ideas for their truth or falsity, and the disclosure of new and unexpected kinds of facts.

So now, we have seen that the artist, the musical composer, the architect, the scientist, etc., all feel a fundamental need to discover and create something new that is whole and total, harmonious and beautiful. Few ever get a chance to try to do this, and even fewer actually manage to do it. Yet, deep down, it is probably what very large numbers of people in all walks of life are seeking, when they attempt to escape the daily humdrum routine, by engaging in every kind of entertainment, excitement, stimulation, change of occupation, etc. etc., through which they ineffectually try

to compensate for the unsatisfying narrowness and mechanicalness of their lives.

Is creativity then something that is appropriate only to a few people of special talents, who rise to a level that is commonly called 'genius'? Clearly, it is not *all* a matter of special talent. For there are a tremendous number of highly talented people who remain mediocre. Thus, there must have been a considerable body of scientists who were better at mathematics and knew more physics than Einstein did. The difference was that Einstein had a certain quality of *originality*.

But what is this quality of originality? It is very hard to define or specify. Indeed, to define originality would in itself be a contradiction, since whatever action can be defined in this way must evidently henceforth be unoriginal. Perhaps then, it will be best to hint at it obliquely and by *in-direction*, rather than to try to assert positively what it is.

One prerequisite for originality is clearly that a person shall not be inclined to impose his preconceptions on the fact as he sees it. Rather, he must be able to *learn something new*, even if this means that ideas and notions that are comfortable or dear to him may be overturned.

But the ability to learn in this way is a principle common to the whole of humanity. Thus, it is well known that a child learns to walk, to talk, and to know his way around the world just by *trying out something* and *seeing what happens*, then modifying what he does (or thinks) in accordance with what has actually happened. In this way, he spends his first few years in a wonderfully creative way, discovering all sorts of things that are new to him, and this leads people to look back on childhood as a kind of lost paradise. As the child grows older, however, learning takes on a narrower meaning. In school, he learns by repetition to accumulate knowledge, so as to please the teacher and pass examinations. At work, he learns in a similar way, so as to make a living, or for some other utilitarian purpose, and not mainly for the love of the action of learning itself. So his ability to see something new and original gradually dies away. And without it, there is evidently no ground from which anything really creative can grow.

It is impossible to over emphasize the significance of this kind of learning in every phase of life, and the importance of giving the action of learning itself top priority, ahead of the specific content of what is to be learned. For the action of learning is the essence of real perception, in the sense that without it, a person is unable to see, in any new situation, what is a fact and what is not.

Of course, there is a routine and mechanical kind of perception that we can carry out habitually, in dealing with what is familiar. This is generally what we tend to do. (e.g. Few people ever note more than a small number of habitually determined salient features of their friends, of the places in which they live, etc.) But real perception that is capable of seeing something new and unfamiliar

requires that one be attentive, alert, aware and sensitive. In this frame of mind, one *does* something (e.g. perhaps only to move the body or handle an object), and then one notes the difference between what actually happens and what is inferred from previous knowledge. From this difference, one is led to a new perception or a new idea, that accounts for the difference. And this process can go on indefinitely without beginning or end, in any field whatsoever.

One thing that prevents us from thus giving primary emphasis to the perception of what is new and different is that we are afraid to make *mistakes*. From early childhood, one is taught to maintain the image of 'Self' or 'Ego' as essentially perfect. Each mistake seems to reveal that one is an inferior sort of being, who will therefore, in some way, not be fully 'accepted' by others. This is very unfortunate. For as has been seen, all learning involves trying something and seeing what happens. If one will not try anything until he is assured that he will not make a mistake in whatever he does, he will never be able to learn anything new at all. And this is more or less the state in which most people are. Such a fear of making a mistake is added to one's habits of mechanical perception in terms of preconceived ideas and learning only for specific utilitarian purposes. All of these combine to make a person who cannot perceive what is new and who is therefore mediocre rather than original.

Evidently, then, the ability to learn something new is based on the general state of mind of a human being. It does not depend on special talents, nor does it operate only in special fields, such as science, art, music or architecture. But when it does operate, there is an undivided and total interest in what one is doing. Recall, for example, the kind of interest that a young child shows when he is learning to walk. If you watch him, you will see that he is putting his whole being into it. Only this kind of whole-hearted interest will give the mind the energy needed to see what is new and different, especially when the latter seems to threaten what is familiar, precious, secure, or otherwise dear to us.

It is clear that all the great scientists and artists had such a feeling for their work. But no matter what his occupation may be, anyone can, in principle, approach life in this way. Here, I am reminded of Anne Sullivan, who was the teacher of Helen Keller. When she came to teach this child, who was blind and deaf from an early age (and therefore unable to speak as well), she knew that she would have to treat her with complete love. However, on first seeing her 'pupil', she met a 'wild animal', who apparently could not be approached in any way at all. If she had seen only according to her preconceptions she would have given up immediately. But she worked with the child as best she could, with all the energies at her disposal, remaining extremely sensitively observant, 'feeling out' the unknown mind of the child, and eventually *learning* how to communicate with her.

The key step here was to teach the child to form a *concept* (which she had never learned, because she had not been able to communicate with other people to any significant extent). This was done by causing her to come in contact with water in a wide variety of different forms and contexts, each time scratching the word 'water' on the palm of her hand. For a long time, the child did not grasp what it was all about. But suddenly she realized that all these different experiences referred to one substance in its many aspects, which was symbolized by the word 'water' scratched in her palm. This initiated a fantastic revolution in the whole of her mind, the depth and scope of which we find it hard to appreciate, without having experienced directly what it means to live without conceptual abstractions. As a result, where there had been a child without the ability to communicate or even to think, there was now a more or less normal human being. Thus, the discoveries of Anne Sullivan were extraordinarily creative, not only in helping transform the life of Helen Keller, but later, also of a large number of other people in similar situations.

This example is especially worth considering, because it shows by contrast how unperceptive and uncreative most parents and teachers are. Very few indeed have the love for children which makes them observant and sensitive to the *actual fact* of how children are in reality *different* from what people expect them to be, and of how an understanding of this difference might well be the key to a transformation as remarkable as that initiated by Anne Sullivan in Helen Keller. Therefore, they miss the opportunity to be creative and original.

Such an opportunity arises in many fields which may at first show little promise, especially because (at least at first) society is not in the habit of *recognizing* them to be potentially creative. Indeed, real originality and creativity implies that one does not work *only* in fields that are recognized in this way, but that one is ready in each case to inquire for oneself as to whether there is or is not a fundamentally significant difference between the actual fact and one's preconceived notions that opens up the possibility for creative and original work.

Having seen that creativity of *some* kind may be possible in almost any conceivable field and that it is always founded on the sensitive perception of what is new and different from what is inferred from previous knowledge, we shall now go on to inquire in more detail into what it actually is. In other words, what does a person do, when he is being original and creative, that distinguishes him from one who is only mediocre?

We can begin to see the meaning of the question by asking first: 'What is characteristic of the *results* of creative action; i.e. the scientific theory, the work of art, the building, the child who has been rightly brought up and educated, etc.?' Here, we must distinguish between an occasional

act of penetrating insight and the discovery of something new that is really creative. In the latter, I suggest that there is the perception of a *new basic order* that is potentially significant in a broad and rich field. This new order leads eventually to the creation of new structures having the qualities of harmony and totality, and therefore the feeling of beauty.

To understand what this means, however, we must first go into what is signified by the terms 'order', 'structure', 'harmony' and 'totality'. Let us begin with order. Now, it is commonly believed that terms like 'order' and 'disorder' refer *only* to subjective judgments, which are completely dependent on the particular tastes, prejudices and opinions of different people. I wish to suggest here that order is not a purely subjective quality, and that on the contrary, judgments concerning it can have just as objective a basis as those concerning, for example, distance, time, mass, or anything else of this nature. For, as I shall try to explain presently in more detail, such judgments are based on the perceptual discrimination of *similar differences* and *different similarities*, which can be defined and communicated just as well as can be done with other qualities that are commonly recognized to be capable of an objective description.

Consider, for example, a geometrical curve, which is, in a certain way, evidently an *ordered* set of points. To express this order in a precisely communicable and perceptually testable way, we can regard the curve approximately as a set of lines of equal length. The lines are thus *similar* in their lengths, but generally *different* in their orientations. But the existence of a regular curve (rather than an arbitrary array of points) evidently depends on the *similarity of the differences*. These are, of course, immediately noted by the eye, even though our common language is generally too crude and impoverished to allow us to communicate exactly what it is that the eye has seen.

It is just because people find that they cannot communicate their very often genuine perceptions regarding the quality of order that they are inclined to assume that these perceptions are purely private and subjective. Clearly, it is necessary to avoid such a tendency to fall into confusion, by developing a language that can describe the quality of order properly. As a first step toward doing this, let us begin by considering a few simple examples of orders of curves.

Now, the simplest curve is a straight line. Here the successive segments differ only in position, and are similar in direction. Then comes the circle. Successive segments also differ in direction. But the angles between them are the same, so that the differences are similar. However, the *similarities* defining the circle are *different* from those defining the straight line. This, in fact, is the essential *difference* between the two curves. The next curve is a spiral. This is obtained when successive pairs of segments differ in that they define different

planes, so that the curve turns into the third dimension. The similarity of these differences leads to a regular spiral.

Evidently, it is possible to go on to higher order differences, whose similarities generate a series of *ordered* curves of ever greater complexity. Here, it is important to note that the 'complexity' of a curve is in fact an objectively definable property of its order. Thus, a straight line is determined by its first step, so that it is a curve of first order. A circle is a curve of second order, determined by its first two steps, while a spiral is a curve of third order, determined by its first three steps. One can imagine curves requiring more and more steps to define them. Eventually, one would come to curves requiring an unlimited number of steps, which would be called 'curves of infinite order'. The extremely complicated paths traced by atomic particles in 'chaotic' movement in a gas, or by small smoke particles in Brownian motion, would be examples of curves of infinite order.

Now, it is commonly stated that particles of the kind described above are moving in a state called 'disorder'. In my view, there is no such thing as 'disorder', if this term is meant to indicate a *total absence of order of any kind whatsoever*. For whenever anything happens, it evidently occurs in *some* kind of order, which can in principle be described in suitable terms. Thus, the order of planetary motion is evidently a simple one that is determined in effect by the first step (and by the forces experienced by the planet in its motion). On the other hand, the order of Brownian motion is as has been seen, an infinite one, in the sense that it could be described only in terms of an unlimited set of similar differences. However, such a movement has certain statistical regularities or symmetries which do not depend significantly on the precise details of the path of its orbital curve. For example, in the long run and on the average, the particle spends nearly the same time in any unit volume of the space that is accessible to it. And if there are many such particles, they are almost always distributed nearly uniformly in the container, at any given moment. Clearly, these features of the infinite order of Brownian movement are just as factual, communicable, and testable as are the features of the order in which an object falls to the ground or a planet moves through space. None of them is only a result of purely subjective judgments, as to what would constitute 'order' or 'disorder'.

Indeed, as has been seen, what is commonly called 'disorder' is merely an inappropriate name for what is actually a certain rather complex kind of order that it is difficult to describe in full detail. Our real task can, therefore, never be to judge whether something is ordered or disordered, because *everything* is ordered, and because disorder, in the sense of the absence of every conceivable kind of order, is an impossibility. Rather, what one really has to do is *to observe and describe the kind of order that each thing actually has*. The term

'disorder' thus serves no useful purpose anywhere and is in fact always a source of confusion. What is needed to remove this confusion is to use instead a language expressed in terms of similar differences, and different similarities, which enables us in principle to describe the actual order of each thing, whatever it may be (just as a language expressed in terms of units of length enables us to describe the actual distances of things from each other).

Let us now go on to discuss the meaning of the term 'structure'. I wish to suggest that structure is in essence a hierarchy of orders, on many levels. Consider, for example, a house. The basically similar elements are the bricks. But these *differ* in position and orientation. When these are *ordered* in a certain array of similar differences, they make a wall. But now, the wall is an element of a *higher order*. For the different walls, arranged with suitable similarities in place and orientation make the rooms. Likewise, the rooms are ordered to make the house, the houses to make the street, the streets to make the city etc. etc.

The principle of structure as a hierarchy of orders is evidently universal. Thus, the electrons and nuclear particles ordered in a certain way make the atoms. These latter are ordered in various ways to make matter at the microscopic level, whether liquid, solid, or gaseous, crystalline or non-crystalline, etc. etc. This principle goes on up to the planets, the stars, the galaxies, galaxies of galaxies, etc., continuing to be valid as far as man has been able to probe with his scientific instruments. Similarly, protein molecules ordered in a certain way make the living cell. Cells ordered in a certain way make the organs. These are ordered to make the organisms, which in turn are ordered to make the society of organisms, until we cover the whole sphere of life on Earth (and perhaps ultimately extending to other planets).

It seems clear from the above that the evolutionary process of nature (which includes the development of man and his intelligent perceptions) is at least potentially of an infinite order, in the sense that it is not *fully* determined by any of its partial orders. In this respect, it is similar to the random curve of Brownian motion. However, it differs from Brownian motion in that it does not tend to approach a state of complete statistical regularity or symmetry. Rather, as has been seen, each order can become the basis of a new higher order, to form a continually evolving hierarchy, leading to new structures that are generally able to order those of a simpler nature (e.g. as the nervous system orders the mechanical movements of the muscle cells). Thus, it can be seen that nature is a *creative process*, in which not merely new structures, but also new *orders of structure* are always emerging (though the process takes a very long time, by our standards).

The basic principle in the development of all structure (whether natural or man-made) is clearly that each kind of order has only an *approximate* and *limited* kind of symmetry. The regular array

of breaks or changes in the symmetry of one order are the basis of another level of order, and so on to higher levels. The universal validity of this principle implies, of course, not merely the possibility of the unending growth of a hierarchy of harmonious orders leading to the evolution of ever more encompassing and unified totalities. It can also lead to the possibility of *conflict* and *clash* between different orders, that will produce, not harmonious and unified totalities, but rather, a process of destruction and decay of the partial orders.

As happens with the notion of order itself, there is a widespread belief that the distinction between conflict and harmony is a purely private and subjective kind of judgment. One can see, however, that it is not *entirely* subjective, if one notes that conflict is a movement in which the orders of the various parts do not work together in a coherent way, such that each partial order is compatible with all the others, and indeed, in many cases, even necessary for their existence.

A very elementary example of conflict or clash can be seen as an intersection of roads. Normally, the function of a traffic signal is to help keep the orders of traffic in the two roads harmoniously co-ordinated. When the signal is not operating properly, then the co-ordination is gone, and the cars will collide at the intersection, destroying both themselves and their drivers. Or to take a more subtle example, consider the function of the digestive organs which, when a person is ill, will fail to follow the normal and proper order of operation needed for the health of the organism as a whole. Or else, one can think of a cancer, whose order of growth without limit is evidently such as to clash with the processes of the body. In all these cases, what we have to deal with is, of course, not disorder or the absence of order, but rather, it is *well defined order that is functionally wrong*, in the sense that it does not lead to a harmonious totality, but rather to clash and conflict of the many partial orders.

Having seen that the perception of harmony and totality need not be a purely private kind of judgment, one can now understand in a new light the fact that the really great scientists have, without exception, all seen in the structural process of nature a vast harmony of order of indescribable beauty. It seems likely that this perception was at least as valid as were those leading to precisely defined theories and formulae, permitting the exact computation of some of the detailed characteristics of the properties of matter. Indeed, every great scientific theory was in reality founded on such a perception of some very general and fundamental feature of the harmony of nature's order. Such perceptions, when expressed systematically and formally, are called 'laws of nature'.

To express some fundamental feature of the order of natural process in terms of a universal law is, however, actually to assert what are the basic *differences* that are relevant for the whole

of this process, and what are the corresponding similarities in these differences. Thus, Newton assumed that generally speaking, the relevant differences were in the positions and velocities of material bodies at successive moments of time. In empty space, the distances covered by such bodies in similar intervals of time were assumed to be similar in magnitude and direction, thus leading to motion in a straight line at a constant speed (which is of course the well known law of inertia). In the presence of matter, it was assumed that these successive distances and their directions were different. However, their *differences* (which define the acceleration) were assumed to be universally similar, in the sense that similar forces would always and everywhere produce similar accelerations. When expressed in precise mathematical terms, these assumptions led to Newton's laws of motion.

A part of Newton's ideas was that the fundamental differences in position were to be thought of as being in an absolute space and taking place in an absolute time. That is to say, he supposed that space and time differences were universally similar, in such a way that different observers would all agree on what was the same interval of time and the same distance in space. Einstein's really creative insight was to see that the facts available to him (which were such as to put physical theory into a considerable state of confusion) could be clearly understood, if we supposed that observers going at different speeds are actually attributing the property of simultaneity and of being at the same distance to *different* sets of events. However, he also saw that observers having similar differences of velocity would have similar differences in their ways of choosing the sets of events to which the properties of simultaneity and of being at the same distance were attributed. When expressed in precise mathematical terms, this led to the well known Lorentz-transformation laws, which were at the foundations of the mathematical theory of relativity.

So, it is clear that Einstein's basic step was to perceive a new set of essential differences, from which there arose a new relationship of similarity, and thus a *new order of space and time*. Since space and time are fundamental to all our conceptions, this new order had to have a broad and deep significance. In terms of this new order, it became natural to ask new kinds of questions in the investigation of physical phenomena, and scientists were thus led to entirely new notions concerning the general properties of matter (which included, for example, the discovery of the equivalence of mass and energy that had such a revolutionary significance).

If one reflects on this situation, however, one will understand that Newton also perceived a new basic difference, and thus creatively initiated a new order in physics. To see this, let us go back to the ancient Greeks, who regarded the key or essential difference as being between the imperfection and corruption

of Earthly matter and the perfection and purity of Heavenly matter (and who thus generalized the moral notion of the difference between imperfection and perfection as the fundamental one, relevant for the whole of existence). The complicated movements of Earthly matter were taken as revealing its imperfect nature. On the other hand, Heavenly matter should express the perfection of its nature by moving in a circle, which was considered to be the most perfect of geometrical figures.

If observation had disclosed that Heavenly bodies do, in fact, move in perfect circles, this would have been a tremendous discovery, tending strongly to confirm the notion that a key difference in the universe is between the perfection of Heavenly matter and the imperfection of Earthly matter. But when observations did not disclose this, astronomers began to accommodate the difference between fact and theory by fitting the fact to a set of circles within circles as epicycles. If a few epicycles had been enough, this too would have been a significant discovery. But when the number of epicycles began to increase greatly, one should have begun to suspect that the distinction between Heavenly matter and Earthly matter was not a fundamental one. But for various reasons (religious, political, psychological, etc.) this notion was not seriously entertained for a long time. Instead, there arose a tendency to focus on the utilitarian aspects of the theory of epicycles (e.g. they were useful for astrological and navigational purposes).

Although it would be wrong to discount the value of such useful computations altogether, one must nevertheless be struck by the contrast between the deep, fundamental and all embracing questions raised by the ancient Greeks, and the subsequent emphasis on relatively narrower, petty and limited purposes. Thus, for a long time, scientists lost much of their earlier impetus toward originality and creativity, and tended instead toward the attitude of wishing mainly to accumulate potentially useful knowledge, within an essentially fixed framework of concepts.

As a matter of fact, before the accumulation of such knowledge could begin to realize even its potential utilitarian value, it was necessary that a new spirit should arise, which questioned the assumption of a fundamental difference between Heavenly and Earthly matter. In the work of Galileo and Newton, it was perceived that a much more relevant set of differences are, as has already been indicated, in the successive states of movement of each particle of matter. And in Einstein's theory, further fundamental differences were assumed to be in the set of times and places that are to be taken as simultaneous and equidistant. Quantum theory brought in other fundamental differences, into which we have no space to go here.

It seems clear that the creative development of science depends quite generally on the perception of the irrelevance of an already known set of

fundamental differences and similarities. Psychologically speaking, this is the hardest step of all. But once it has taken place, it frees the mind to be attentive, alert, aware and sensitive, so that it can discover a new order and thus create new structures of ideas and concepts.

The relationship of a creative scientist to the results of the creative work of earlier scientists is of crucial significance here. Evidently, such a scientist cannot be similar to Einstein in the quality of creativity if he merely applies what Einstein did to new problems, or even varies, extends and develops it so that it reveals its full implications in synthetic combinations with other theories that are already known. Nor of course would such a scientist be creative merely by reacting against Einstein's work or by ignoring it altogether. Rather, what is called for is that he *learn* from Einstein in the sense that he not only understands what the latter did, but also perceives the differences between the insights of Einstein and those that are now developing in his own mind as he works on the subject (which will evidently be different from Einstein's not only because he has new knowledge, experimental and theoretical, but also for countless other reasons of a nature that it is difficult or impossible to specify in detail). It is the feeling out of such differences that will indicate the new similarities that are appropriate to his own situation. These new similarities will eventually lead to a different set of laws of nature, which should, however, contain what was correct in Einstein's laws as special limiting cases and approximations.

Thus, a creative new perception leads, as it were, to a new order in the hierarchy of our understanding of the laws of nature, which neither imitates the older orders nor denies their validity altogether. Indeed, it serves, as it were, to help to put our knowledge of the older laws into a more appropriate order, while at the same time it extends the frontiers of knowledge in quite new ways. But generally speaking, there is no reason to expect that any given set of natural laws will have an unlimited domain of validity. Rather, when any laws are applied beyond their proper domain, it will almost certainly be found that the corresponding fundamental differences defining nature's order in this domain, eventually cease to be similar. Indeed, the *differences will now be different*. This leads in turn to new similarities and thus to the perception of new orders and the creation of new structures. So, in a way, the order and structure of our knowledge of natural law is always evolving, by a principle similar in certain ways to that of the order and structure of nature; i.e. by similar differences, leading to different similarities, in an ever growing hierarchy of orders, that forms, as it were, a living body of natural law.

It is not merely in science that perception of relevant differences is the basic step. Actually, all perception begins with the perception of such differences. This is because the nerves accommodate

to a signal that remains similar to what it was, until they produce little or no response. Then a difference suddenly stands out very sharply in awareness.

Consider, for example, what happens when one drops a coin on a highly patterned carpet. It is usually almost impossible to see it. But when one sees a glint of metal, the coin suddenly stands out, and is clearly visible. What one actually perceived was the *difference* between the previous state of the carpet and the state with the *glint* in it. This caused one to recollect *similar differences* in past experiences, when metal objects caused such glints to appear against a non-metallic background. Thus, one can now easily see the coin, because the whole pattern of differences between it and the carpet fits into an already known pattern of similar differences.

A great deal of our perception is necessarily of this character, which is relatively mechanical, in the sense that the order, pattern and structure of what is perceived come from the record of past experiences and thinking. To be sure, this record is varied, adapted and adjusted so as to accommodate the presently perceived fact. But basically, it is not new.

A somewhat higher level of perception occurs when one thinks of a past order and structure that is not commonly associated with the observed set of differences. For example, one may see that the differences in some observed field of phenomena are similar to those in some rather different and, at first sight, apparently unrelated field of phenomena. So one is led to apply known kinds of ideas in new contexts. One of the most famous examples of such perception is that of Archimedes, who suddenly understood that the differences in volumes of different bodies is always similar to the differences in the amount of water that they displaced. That is to say, the order of volumes of objects was seen to be similar to the order of the volumes of water displaced by them. Therefore, by measuring the amount of displaced water, one could distinguish the specific gravities of different bodies, even though their shapes were too complicated to allow their volumes to be calculated directly from their geometrical properties.

Such a penetrating insight may lead to important discoveries, and to new inventions of considerable practical importance. Yet, it is not creation. For in creation, one perceives a new fundamental set of similar differences, that constitutes a genuinely new order (and not merely a relationship between two or more orders that are already known). This new order leads hierarchically to a wide range of new kinds of structure. Generally speaking, an isolated penetrating insight connecting up one field with another falls far short of doing all this.

Perhaps the original and revolutionary nature of a genuinely creative perception can be illustrated very strikingly if one considers the experience of



Helen Keller, when she suddenly perceived the nature of conceptual abstractions. In the beginning, she had merely been aware of a series of differences; i.e. the difference between her usual state of mind and the state of being exposed to various aspects of what we know to be water (but which she, of course, did not know anything about). The clue of similar structure in the different sensations scratched on her hand on each occasion led her, at a certain point, to understand that all these differences were basically similar. This understanding was not merely a result of what she had known before, nor was it even merely the perception of a new relationship in orders that she had already encountered before. It was, in fact, the first perception of an entirely new order in the mind; i.e. the order of the concept. And when these concepts were in turn ordered in a hierarchy, this led to a new structure of the mind as a whole enabling her to communicate with others and to think for herself. Thus, not only was the teacher very creative, but in a way, the pupil underwent a transformation that was of an even higher order of creativity.

So to sum up, we may say that quite generally, in a creative act of perception, one first becomes aware (generally non-verbally) of a new set of relevant differences, and one begins to feel out or otherwise to note a new set of similarities, which do not come *merely* from past knowledge, either in the same field or in a different field. This leads to a new order, which then gives rise to a hierarchy of new orders, that constitutes a set of new kinds of structure. The whole process tends to form harmonious and unified totalities, felt to be beautiful, as well as capable of moving those who understand them in a profoundly stirring way.

Evidently, creation of this kind has been fairly rare. In the whole of human history, perhaps only a few people have achieved it. Most of the rest of human action has been relatively mediocre, though it is interlaced with flashes of penetrating insight that help to raise it above the level of mere humdrum routine. The reason is that creative work requires, above all, a creative state of mind. And generally speaking, what we learn as children, from parents, teachers, friends and society in general, is to have a conformative, imitative, mechanical state of mind, that does not present the disturbing danger of 'upsetting the apple cart'. And then, most of those who are not satisfied with such conformity fall into the trap of *rebellious against it*, by projecting an opposing or contrary set of ideals, and trying to conform to these. But evidently, such conformity is also not creative. For reasons that are hard to specify, a few people escape both these kinds of conditioning to mechanicalness in the operation of the mind. And of these few, a very small number indeed manage to escape the gigantic conflicts, internal and external, which may be initiated by the fear of upsetting the existing state of affairs, on which our security, our happiness, and even our lives, often seem to depend.

What then is the creative state of mind, which so few have been able to be in? As indicated earlier, it is first of all, one whose interest in what is being done is whole-hearted and total, like that of a young child. With this spirit, it is always open to learning what is new, to perceiving new differences and new similarities, leading to new orders and structures, rather than always tending to impose familiar orders and structures in the field of what is seen.

This kind of action of the creative state of mind is impossible, if one is limited by narrow and petty aims, such as security, furthering of personal ambition, glorification of the individual or the state, getting 'kicks' and other satisfying experiences out of one's work, etc. etc. Although such motives may permit occasional flashes of penetrating insight, they evidently tend to hold the mind a prisoner of its old and familiar structure of thought and perception. Indeed, merely to inquire into what is unknown must inevitably lead one into a situation in which all that is done may well constitute a threat to the successful achievement of those narrow and limited goals. (e.g. A genuinely new and untried step may either fail altogether or else even if it succeeds, it may lead to ideas that are not 'recognized' until after one is dead).

Besides, such aims are not compatible with the harmony, beauty, and totality that is characteristic of real creation. Architects will understand that the petty and limited motives of those who want to have buildings constructed has led to cities that are very hard to live in, because they are so full of the clashing orders of conflicting movements of traffic and the decaying orders of slum areas, as well as because their overall design and structure are at best mediocre, and at worst, positively ugly. Something similar is involved in all men's activities in science, art, education, or what have you.

This sort of thing is clearly inevitable. For when each man in each group acts in a particular and independently determined order, how can it be otherwise than that these orders will generally be in a state of clash and conflict? (Recall, for example, the clash of traffic at an intersection without a signal, or the destruction of an organism in which is growing a cancer, whose cells multiply without regard for the order of the organism as a whole). A similar order of chaotic clash and conflict is manifest, not only in our daily lives and in our general social organization, but also, in the relationships between nations, which is now such as to threaten all with annihilation.

Evidently, then, the mechanical and uncreative character of most human activity tends, at the very least, to lead to what may be called a 'general mess'. Perhaps in the past, it may have seemed reasonable to many to hope that the net result of these myriads of conflicting mechanical orders would lead in the long run to overall progress, with ever greater harmony and happiness. But more recently, the actual course of the development of society has been such as to make it very

difficult to believe that anything but ultimate destruction, physical and mental, is likely to emerge from the process, if it goes on indefinitely.

This 'general mess' is, however, not really an entirely new thing. The fact is that for a long time, many people have realized that the order of society is not a genuinely healthy one. Indeed, throughout the course of history, various individuals have, from time to time, tried to initiate a new and better order, by means of the violent imposition of certain preconceived ideas as to what would produce a creative state of social harmony. But events have generally proved that this never works as anticipated. The reason is that a preconceived idea of producing social harmony is in reality just as mechanical and arbitrary as is the chaotic state of conflicting orders which it aims to eliminate. This is, indeed, the basic defect of every form of violence—i.e. that it is necessarily and inevitably mechanical. For this reason, violence can only serve to replace earlier forms of clash and conflict by others, that are in many cases, even more dangerous and destructive than those that were present to begin with. The desire for power to enable one violently to impose his ideas on society is therefore based on a meaningless delusion.

What is really needed to create a genuinely new order in any field whatsoever (and not merely a mechanical continuation in modified form of the conflict of fragmentary orders) is the state of mind that is continually and unceasingly observant of the fact of the actual order of the medium in which one is working. Otherwise, one's efforts are foredoomed to failure, because the order of what is done will not correspond to the actual nature of things. And this will make conflict of *some* kind inevitable. Indeed, no really creative transformation can possibly be effected by human beings, either in nature or in society, unless they are in the creative state of mind that is generally sensitive to the differences that always exist between the observed fact and *any* preconceived ideas, however noble, beautiful, and magnificent they may seem to be.

We have seen that society is in a 'mess', which is the result of the conflict of arbitrary and fragmentary mechanical orders of relatively independently determined actions. Any effort to *impose* on overall order in this 'mess' will serve only to make it worse. What then is to be done? I would suggest that it is a wrong order of approach to try *first* to solve the social problem. Rather, the key is in the state of mind of the individual. For as long as the individual cannot really learn from what he does and sees, whenever such learning requires that he go outside the framework of his basic preconceptions, then his action will ultimately be directed by some idea that does not correspond to the fact as it is. Such action is worse than useless, and evidently cannot possibly give rise to a genuine solution of the problems of the individual and of society.

So fundamentally, the wrong order of human

action that is responsible for our basic difficulties is due to the fact that we tend to be mechanical when what is called for is creativity. Of course, there is a right place for mechanical orders of action. Thus, we must have a great many agreed conventions (such as driving on the same side of the road) which are essentially mechanical. Moreover, our machines must evidently function in a well defined order, or else they will break down. But when we try to apply a mechanical order to the functioning of the mind as a whole, then we are extending this order beyond its proper domain. For example, when parents are not content to tell a child how to *behave* (which is in general a reasonable thing to do), but tell him what sort of a person he *should be* (e.g. the exhortation 'Be a good boy!') then this implies the effort to impose a mechanical pattern very deeply in the whole order in which the mind operates. A similar effort is implied when the child is told *what he should think* (e.g. on the basis of authority, to adopt certain opinions as to what is 'right and proper') and *what he should feel* (e.g. love for his parents and hatred for the enemies of his country). Because the mind is not a mechanical thing, it cannot actually hold to such an order. Thus, the child who learns to be mechanically obedient cannot help harbouring feelings of aggression against those whom he is supposed always to love, while the child who learns to be mechanically aggressive and dominant cannot help feeling lonely and frightened when those whom he tries to dominate fail to love him.

If we recall the notions of order discussed earlier, we could perhaps say that like the processes of nature, those of the mind are basically of an infinite order that is always tending to evolve toward new orders, and thus to develop hierarchies constituting new kinds of structure. On the other hand, every mechanical order is limited in certain ways, so that it cannot respond adequately to what is new and creative. Thus, any effort to impose a mechanical order on the mind will lead, not to the expected result, but rather, to additional unforeseen reactions that *conflict with the order that one wishes to impose*. Mechanical ideas must, therefore, be restricted in their application to limited domains which can correctly be abstracted in some degree of approximation as mechanical. But more generally, whether one is dealing with the mind or with external nature in the broader aspects, one needs to be ready at any moment to learn something that may be basically new. And this is possible, only when the mind is original and creative, rather than mediocre and mechanical.

If one is at all sensitive and observant, he can actually perceive just how the mind goes into a wrong order of operation, when it tries to follow a mechanically imposed pattern, that involves the deeper things, such as what sort of a person one *is*, what one should think and feel, etc. Evidently, the mind is then in a state of contradiction, because one part of it thinks one *should* follow the

imposed pattern, while another part thinks one *should not* do so. The fact is that both parts constitute mechanical and fragmentary orders of operation that conflict with each other, in the sense that they cannot be carried out together. One can actually perceive this order of conflict, which is sensed as a painful state in which one has strong wishes and urges that pull him in two directions at once.

What is called for in such a conflict is that the mind shall be able to see the irrelevance of all mechanical patterns as to what one should be, or think, or feel. Indeed, the disharmony that inevitably arises from trying to impose or follow such a pattern can come to an end, only through the creative response of the mind, from moment to moment, which alone can give rise to a harmoniously ordered totality in the psyche, rather than to a structure of conflicting fragments. But because the conflict is generally very painful, the mind tends to try to 'escape' awareness of what is happening, before it has the opportunity to respond in this way. This it does by initiating a state of *confusion*.

Of course, there is a kind of *simple confusion* that tends to arise, whenever we are presented with a complex array of new facts and perceptions. Normally, it takes some time to allow all this to be 'sorted out'. During this time, it is properly one's wholehearted intention to arrive at a clear perception of what has been previously 'mixed up'. However, when the mind is trying to escape the awareness of conflict, there is a very different kind of self-sustaining confusion, in which one's deep intention is really to avoid perceiving the fact, rather than to 'sort it out' and make it clear.

Whenever this is happening, we tend to say that the mind is in a state of 'disorder'. But in fact, the mind can then be seen to be following a well defined order, that is functionally wrong (as, for example, is the order in which the digestive organs allow food to ferment, rather than to be assimilated into the blood in a proper form). The essence of this wrong order is that every time the mind tries to focus on its contradictions, it 'jumps' to something else. It simply won't stay with the point. Either it continues to dart from one thing to another, or to react with violent excitement that limits all attention to some triviality, or to become 'dead', 'dull' or 'anaesthetized', or to project fantasies that cover up all the contradictions, or to do something else that makes one momentarily unaware of the painful state of conflict in which the mind is. This order of self-sustaining confusion tends to spread to other fields, so that eventually the whole of the mind begins to deteriorate.

When the process of general deterioration in the order of operation of the mind reaches a certain point, a person's conflicts are then said to have made him *neurotic*. Everybody can then recognize that there is something deeply wrong in the way such a person's mind works. However,

closer observation shows that a basically similar state of conflict, covered up by self sustaining confusion, prevails in what is commonly called the 'normal' state of mind. It is this conflict and confusion in the minds of each of us that has created the 'mess' in which the individual and society now find themselves. In other words, the 'mess without' is *mainly* a result of the 'mess within' (though of course there is a secondary action in which external conflicts also stir up internal conflicts).

So it is futile for people whose minds are in the confused state of evading awareness of the clash of conflicting orders within to hope to create either a harmonious life for the individual or a harmonious order of society as a whole. Unless the mind first comes to a state of relatively undivided wholeness, in which it is not trying to avoid awareness of unpleasant conflicts of a fundamental nature, the problems of the individual and of society cannot do other than develop according to the clash of opposing forces that are set off by our confused mechanical reactions. Indeed, it can safely be said that in the long run, no really subtle, deep and far-reaching problems can be solved in any field whatsoever, except by people who are able to respond in an original and creative way, to the ever changing and developing nature of the overall fact by which they are confronted.

We have thus come to the point of seeing that the question of being clearly aware of the difference between the creative and the mechanical character of human responses goes far beyond limited fields such as art, science, etc. Rather, it involves the whole human life, and on it may depend even the survival of the human race as a whole. What is needed is a generally creative quality of living in all areas of human activity. But how are we to achieve this? Given that we have been generally conditioned to mediocrity and mechanicalness, how are we to break out of this conditioning?

It seems that in some way, each person has to *discover* what it means to be original and creative. After all, generally speaking, the child-like quality of fresh wholehearted interest is not entirely dead in any of us. It comes in a small burst, and then it gets lost in confusion as all the old special interests, fears, desires, aims, securities, pleasures, pains etc. come up from the past. These twist the fresh clarity of the mind in a mechanical way, so that the capacity for originality and creation are deadened and gradually 'go to sleep'. As a result, the more subtle capacity for original and creative perception has by now atrophied, so that it is generally rather weak and inactive.

In this connexion, I am reminded here of what happened when I first got on a horse many years ago. The man from whom it was being hired told me: 'You must think faster than the horse, or else you will go where the horse wants to go'. This made a deep impression on me, because it contained an important truth, i.e. that a given

process can be ordered only by the intervention of a faster, finer, more subtle order of process. Thus, the rider is able, by tiny pulls on the reins to change the overall order of movement of the horse. Likewise, the original and creative action of the mind could probably direct the mechanical function in a corresponding way. For it could see where the mechanism was going, long before the latter began to gain an overwhelming momentum in that direction.

But now imagine that the mechanical jogging of the horse has put the rider to sleep. Occasionally, the rider wakes up and is horrified to see where the horse is taking him. So he corrects the direction of the horse and the jogging soon sends him back to sleep again. Perhaps eventually the horse also begins to worry about whether he will ever be able to find his way back to the stable. So it occurs to him that he should wake up the rider. But he wants first to be sure that the rider will take him back to the stable, where he will get a good meal and a comfortable place to rest. Since his thinking is no match for the rider, he hesitates to awaken the latter, who may well direct him to an entirely different goal.

Similarly, the mechanical reactions of the mind eventually lead to the thought: 'I need a creative response to get me out of this mess'. But then there is the further mechanical thought: 'If I get an original idea, I may make a mistake. People will condemn me. I could lose my comfortable and safe job, etc. etc.' So eventually the mechanical reactions are never able to be really serious in the intention to awaken the creative action of the mind.

Is it possible in any way for the creative action of the mind to awaken? In my view this can be brought about only by the creative response of the mind itself, on those occasions in which it may happen to begin to wake up. It is as if the rider, when he was momentarily jolted out of his comfortable state of somnolence, began to be aware of the mechanical responses that were putting him back to sleep again. Perhaps in this way he could really wake up. Likewise, if one is serious about being original and creative, it is necessary for him first to be original and creative about the reactions that are making him mediocre and mechanical. Then eventually, the natural creative action of the mind may fully awaken, so that it will start to operate in a basically new order that is no longer determined mainly by the mechanical aspects of thought.

In thus emphasizing the need for each individual to realize the creative potentialities of the human mind, I do not wish to suggest that this is merely what I (or other people) happen to want, or what I think would be *useful* to society or to the individual himself. Rather, it seems to me that just as the health of the body demands that we breathe properly, so, whether we like it or not, the health of the mind requires that we be creative. That is to say, the mind is not the sort of thing that can

properly act mechanically. And this is why we always fail whenever we try to be mechanical. The ultimate result is always a painful and unpleasant state of dissatisfaction and conflict, covered up by self-sustaining confusion, in which the mind 'jumps' continually between incompatible orders of operation. This state is not only not creative, but actually it falls far short even of the limited kind of order that is displayed by a good machine.

But of course, to awaken the creative state of mind is not at all easy. On the contrary, it is one of the most difficult things that could possibly be attempted. Nevertheless, for the reasons that I have given, I feel that it is for each of us individually and for society as a whole the most important thing to be done in the circumstances in which humanity now finds itself. And the key is, as I have indicated, to be continually aware of and alert to the basically mechanical reactions that are always causing us to 'go to sleep' again and again.

Just what are these reactions? This is too complex a question to be gone into in detail here. But roughly, it can be said that the root of the trouble is in the confusion between what is really creative and the mechanical continuation of the results of past conditioning. For example, each person will note that either tacitly or explicitly, he is according extremely great importance and value to certain comforts, pleasures, stimulating sources of a 'tingling' sense of excitement and euphoria, secure and satisfying routines of life, actions that are necessary to his feeling of being an accepted and worthwhile sort of person, and various other mental responses that are felt to be of a *supreme degree of psychological significance*. Indeed, such responses often seem so basic to the psyche that one feels that he cannot bear to have them seriously disturbed. Even more, it may often appear that they are inseparable parts of one's 'very self', so that all the creative possibilities of the mind would depend on *first* seeing to it that they are in a right order (as all one's physical actions depend on obtaining an adequate supply of the right kind of food). However, closer observation shows that the continuation of these responses is not really necessary for happiness and creation, and that on the contrary, they are actually nothing but mechanical results of past conditioning, being in fact the principal barriers to real joy and creativity.

Now, as one can discover if he observes himself and other people carefully for a while, the fact is that the mind cannot help but assign supreme value in this way to whatever *appears to be* creative or necessary for creation. It is therefore clear that the confusion of the creative with the mechanical will have extremely deep and far-reaching consequences for the whole of the mind, with effects going immensely beyond those of more narrow and restricted kinds of conflicts. Indeed, what happens is that when the mechanical, mistaken for the creative,

begins to display its inherent contradictions (so that its very existence seems to be threatened), the whole energies of mind and body are mobilized to 'protect' the apparently supremely precious thoughts and feelings that are thus 'endangered'. As has been indicated, it is enabled to do this by falling into a state of self-sustaining confusion, in which it is no longer aware of its contradictory thoughts and the painful conflicts that result from them. In doing this, it lacks clear perception in almost any area that may be at all subtle. Thus, it can no longer see what is creative and what is mechanical. Indeed, the mind then starts to suppress real originality and creation, because these seem to threaten the apparently creative, but actually mechanical centre that appears to be at the heart of one's 'very self'. It is just this action that constitutes the process of 'falling asleep'.

The tendency to 'fall asleep' is sustained by an enormous number of habitually applied preconceptions and prejudices, most of which are absorbed at a very early age, in a tacit rather than explicit form. Therefore, whoever is really interested in what it means to be original and creative will have above all to pay careful and continual attention to how these are always tending to condition his thoughts, feelings and overall behaviour. After a while, such a person will begin to notice that almost all that is done by the individual and by society is in fact rather strictly limited by such largely tacit and essentially mechanical constraints. But as he becomes sensitively aware of how the whole process works, in himself and in others, he is likely to discover that the mind is beginning to come to a more natural state of freedom, in which all this conditioning is seen to be the triviality that it really is.

Thus, originality and creativity begin to emerge, not as something that is the result of an effort to achieve a planned and formulated goal, but rather, as a by-product of a mind that is coming to a more nearly normal order of operation. And this is the only way in which originality and creativity can possibly arise, since any effort to reach them through some planned series of actions or exercises is a denial of the very nature of what one hopes to achieve. For this reason, originality and creativity can develop only if they are the essential force behind the very first step.

This means that it is up to each person to make the first step for himself, without following another, or setting up another as his authority for the definition of what creativity is and for advice on how it is to be obtained. Unless one starts to discover this for himself, rather than to try to achieve the apparent security of a well laid-out pattern of action, he will be just deluding himself and thus wasting his efforts. To realize this fact is very difficult indeed. Nevertheless, one has to see that to determine the order in which one functions psychologically by following some kind of pattern is the very essence of what it means to be mediocre and mechanical.

But after all, for thousands of years, people have been led to believe that anything and everything can be obtained if only one has the right techniques and methods. What is needed is to be aware of the ease with which the mind slips comfortably back into this age-old pattern. Certain kinds of things can be achieved by techniques and formulae, but originality and creativity are not among these. The act of seeing this deeply (and not merely verbally or intellectually) is also the act in which originality and creativity can be born.

### *De l'Invention*

**Résumé**—Vouloir définir par des mots la capacité d'invention est chose malaisée, ou peut du moins essayer d'indiquer de quoi il s'agit en utilisant des moyens détournés, indirects, en se demandant pour quelle raison les chercheurs s'intéressent si passionnément à leurs travaux. En procédant par élimination, en supprimant les réponses nombreuses et superficielles généralement admises, on ne tarde pas à découvrir que le chercheur s'efforce d'apprendre quelque chose de nouveau, autre que ce qui peut être déduit d'après des connaissances acquises, quelque chose qui pourra aboutir à une nouvelle perception de l'intégralité, de la beauté et de l'harmonie dans l'ordre et la structure du processus naturel. Recherche très comparable à celle de l'artiste, du musicien, de l'architecte et de tous ceux qui sont engagés dans une activité de création véritable, quoique par des moyens très différents.

Il convient néanmoins d'être plus précis lorsqu'il s'agit de définir ce que l'on entend par la notion d'invention créatrice. Qu'est-ce que l'ordre? Qu'est-ce que la structure? Qu'est-ce que le processus? Ces questions sont examinées et certaines réponses sont données dans le présent article, des réponses provisoires tout au moins. Les significations de ces suggestions sont illustrées par plusieurs exemples, pris dans l'histoire actuelle du développement des sciences, quoique pas uniquement restreints à ce domaine.

Reste à savoir pour quelle raison la très grande majorité des êtres humains sont dépourvus de cette capacité créatrice, sauf peut-être en de très rares occasions. Un examen plus poussé indique que dans un certain sens les possibilités créatrices de

l'esprit humain sont en général latentes. Cet état de 'sommeil' est probablement dû à une confusion très répandue et profondément ancrée, qui consiste à ne pas faire la distinction entre création et mécanique.

L'étude se termine par un bref exposé sur ce à quoi l'on aboutirait si l'on arrivait à se libérer d'une telle confusion et de quelle manière cette libération pourrait devenir effective, un jour.