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COMMENTS ON THE IDEA OF PROGRESS

Repreinted from TOTUS HOMO - Vol. 3, n. 1, 1971

Published by
Istituto di Psico-sintesi Scientifica - Milan (Italy)

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INTRODUCTION

It is well known that it is science which is responsible for the idea of progress. Probably no one did more for this idea than Bernard de Fontenelle (1657-1757), father of popular science and famous Secretary of the French Academy of Sciences. There are many biographies of him, a recent good one in English by Marsak (1959). The Encyclopaedists continued on his line from the middle of the 18th century onwards and contributed their share to the popularization of science and the idea of progress. Gradually people came to believe in progress as something automatic and inevitable. The explosion in comfort and commodities generated by the marriage of science to technology seemed to be a chain reaction without end. Today the concept of 'negative feedback' has taken hold of us and we are no longer equally confident about the future of mankind. I need not expatiate upon this point which long has been a favourite subject of numerous articles and books.

Actually there have always been scientists and philosophers unwilling to believe in any real progress. I shall quote one only, the eminent Russian physiologist Pavlov, responsible for pioneer work on the digestive glands and for the exploration of learning by way of conditioned reflexes. In 1922 he said:

« Let the mind rise from victory to victory over surrounding nature, let it conquer for human life and activity not only the surface of the earth but all that lies between the depth of the seas and the outer limits of the atmosphere, let it command for its service prodigious energy to flow from one part of the universe to the other, let it annihilate space for the transference of its thoughts — yet the same human creature, led by dark powers to wars and revolutions and their horrors, produces for itself incalculable material losses and inexpressible pain and reverts to bestial conditions. Only science, exact science about human nature itself, and the most sincere approach to it by the aid of the omnipotent scientific method, will deliver man from his present gloom and will purge him of his contemporary shame in the sphere of interhuman relations » (from Babkin, 1949).

A present-day student of the nervous system, while prepared to believe in progress of our knowledge and basic understanding of brain and mind, has seen so many examples of scientific information being used for political purposes that he will be excused if he tends to be sceptical, even about the kind of guarded optimism offered by Pavlov in his last sentence. Everything we have experienced suggests that if some basic knowledge about how the brain works is being obtained, it will in the end get into the hands of people prepared to make unscrupulous use of it in order to exercise control over their fellow beings.

Pavlov's words also raise the question of what we really ought to mean by 'progress'. There is no doubt but that basic science still has many untapped resources of progress even though in the end it may come to advance in an asymptotic manner. Again, if we are content to define progress by applying a political criterion such as for instance the welfare of the modern welfare state, progress by that criterion is quite likely to last for some time to come. There will

Comments on the idea of progress.

SUMMARY - After a brief review of the historical origin of the idea of progress the author discusses its present state. He refuses to take as his measure advancement purely material and raises the question of whether moral progress can serve as a basis for our judgement. He concludes that this criterion requires normative ethics about which there does not exist any general agreement.

His final conclusion is that reliable standards of judgement can be obtained only by scientific criteria and he proceeds to illustrate by examples progress as a process of adaptation to the environment, pointing out that this influence is inescapable and requires watching and some control, not in the least of the environment The examples have been chosen to illustrate unexpected results of adaptation manifested in our cultural inheritance.

Commenti sul concetto di progresso.

SOMMARIO - Dopo un breve riesame dell'origine storica dell'idea di progresso, l'autore discute il suo stato attuale. Egli rifiuta di prendere come metro l'avanzamento puramente materiale e solleva la domanda se il progresso morale possa servire come base di giudizio. Osserva che un simile criterio richiede un'etica normativa sulla quale non esiste un generale accordo.

La sua conclusione finale è che degli standards di giudizio si

be more comfort and more commodities for more people, to put it briefly. But restricting argumentation to materialistic progress, defined in that way, bypasses the fundamental problem that Pavlov raised in the statement quoted: what about man as such? This question is too serious to be shelved by a reference to practical but essentially trivial ideals belonging to the sphere of political economy.

The great Encyclopaedists of the 18th century did not restrict themselves to applauding Baconian notions about the real purpose of science being to endow human life « with new powers and inventions ». They were out also for enlightenment as such, knowledge for its own sake in order to understand man and his place in nature and to do away with superstition and dogma, social as well as religious. To them this was the most essential aspect of the idea of progress, the one responsible for the optimism and zest for life that attracts us so powerfully to the intellectual climate of that century. Their hope did not die out with them but lasted throughout the 19th century. Indeed, a man as deeply cultivated and intelligent as Renan, still maintained (in 1870) that chemistry, astronomy and general physiology would permit us to penetrate into the « secret of existence, the Universe, God » (a statement from his autobiography).

In his excellent book, « The idea of progress », J.B. Bury emphasized that this idea was something quite new in the history of mankind. He also defined what he meant: « Progress involves a judgement of value, which is not involved in the concept of history as a genetic process. It is also an idea distinct from evolution ». It is impossible to refute Bury's definition. It is true as a description of the new attitude to life fostered by the impact of science upon the minds of the educated citizens of the 18th century. Bury speaks as an historian and humanist and knows what he is talking about. He makes it very clear by emphasizing that « it is from its bearings on the future that Progress derives its value, its interest and its power. You may conceive civilisation as having gradually advanced in the past, but you have not got the idea of Progress until you go on to conceive that it is destined to advance indefinitely in the future ».

However, while all this is acceptable, it is still quite possible to criticize Bury's definition for what it contains worth believing in. Judgements of value are objective only if we accept the existence of a normative ethics, meaning that there is a definite code of values to adhere to everywhere on this globe. If this were so, progress could be measured against the standard of an ultimate goal and we could discuss the question of whether or not mankind has progressed and continuously is progressing towards that goal. If a normative code of ethics did exist, it would likewise be possible to appreciate the writings of some biologists specializing in eugenics or euphenics who want to improve mankind by directing evolution according to ideas — their own, as one must suppose — of what kinds of people are desirable. To me this is an attitude of most preposterous hubris.

As there is no absolutely valid normative ethics, the best one can do with Bury's definition is to take some widely acknowledged virtues, for example those of some great religion like Christianity, and inquire whether in historic times mankind has improved with respect to them. Abolition of cannibalism, superstition and slavery is generally mentioned when this question is raised. The case for slavery is open to some doubt, because, like superstition it may only have assumed a different form. The heretics killed today, directly or indirectly in concentration camps, are tortured because of heresies different in kind only from those of the centuries preceding the age of enlightenment. In criminal bestiality our century has beaten that of Jenghis Khan. Perhaps one could count as a sign of limited ethical progress the expansion of our conscience to embrace the whole world, as evidenced by the approval in most nations of the help given to underdeveloped countries.

In the end few people will agree on the values by which to judge progress, and an increasingly larger number of them are likely to deny that there is any

possono ottenere solo in base a criteri scientifici, e procede quindi illustrando con esempi il progresso come un processo di adattamento all'ambiente, mettendo in rilievo che questa è una influenza a cui non si sfugge e richiede tra l'altro sorveglianza e controllo dell'ambiente stesso. Gli esempi sono stati scelti per illustrare inattesi risultati di adattamento, che si sono manifestati nel nostro retaggio culturale.

Réflextions sur l'idée de progrès.

RÉSUMÉ - Après un bref aperçu de l'origine historique de l'idée de progrès, l'auteur discute son état actuel. Il refuse de prendre comme mètre l'avancement purement matériel et pose la question si le progrès moral peut servir comme base de jugement. Il remarque qu'un tel critère exige une éthique normative sur laquelle il n'existe pas un accord général. Sa conclusion finale est qu'on ne peut obtenir de standards satisfaisants de jugement que sur la base de critères scientifiques; il poursuit donc en illustrant, avec des exemples, le progrès comme un processus d'adaptation à l'environnement, en mettant en relief que c'est là une influence à laquelle on n'échappe pas et qui, non en dernier lieu, exige une surveillance et un contrôle de l'environnement. Les exemples ont été choisis pour illustrer des résultats inattendus d'adaptation qui se sont manifestés dans notre héritage culturel.

cause whatsoever for the optimism that is inseparable from the idea of a continuously improving human race. We are all of us familiar with this trend of opinions in the present age, but, like other opinions, it is based on subjective judgement and our aim is to find an objective criterion to go by.

In spite of Bury's anti-evolutionistic definition of the idea of progress, this, in fact, seems to me the only kind of 'progress' that can be defined and profitably discussed. We ourselves as well as our whole civilisation are a product of evolution. Surely this branch of biology should be able to provide us with a concept of progress on which it would be worthwhile to spend some time in order to understand what has happened and still goes on happening.

PROGRESS AS ADAPTATION TO THE ENVIRONMENT

Progress in evolution takes the shape of an increasingly more perfect adaptation to the conditions which a living organism is experiencing. As a layman in this particular field, I am prepared to accept the arguments of the geneticists that they have been able to define the main factors behind this process. These have been quantitatively analyzed in population genetics and may be described as selection pressure, pooled genetic variability, mutation pressure and size of population engaged in reproduction at any given time (see E.G. Simpson, 1953). The kind of progress that is defined as adaptation is an improvement in the fit of an organism for its 'niche' in nature. In man it has led to the erect posture and the extraordinary development of brain-hand coordination that has made him master of his environment in a sense that no other animal has been able to emulate.

Looking at this process as a physiologist interested in nervous system, one is struck by features of adaptation which are less accessible to study than, for example, genetic inheritance of disease in man or the traditional subjects of chromosomal and gene experimentation with lower forms. The features alluded to are the ones that emerge as unexpected novelties out of the statistical multiplicity of interaction and recombination which the comparatively enormous control organ, our nervous system, has made available. It seems natural for a neurophysiologist to think of increasing improvement of 'control' in the widest sense as the most significant end result of adaptation in the course of evolution. However, in tracing a line of adaptation of a nervous mechanism from lower to higher species and enjoying a measure of satisfaction over the general reasonableness of this operation, suddenly, at one particular step in the process one is lost in bewilderment over the *raison d'être* of why and how an entirely unexpected talent has turned up. Something new appears, surprisingly, as when a white rabbit jumps out of a wizard's hat.

An example from the adaptive development of a sense organ will serve to illustrate what is meant. The structure in question is the so-called acousticolateral organ. When it for the first time can be identified in the most primitive fishes, it consists of small tufts of hairs sticking out into the water from special cells on the surface of the body. In elasmobranchs and teleostean fishes these groups of sensory cells are found enclosed within a system of tubes on the sides of the body along its length axis, open at the ends. This is the lateral line (Fig. 1), easily seen with the naked eye. On each tuft of cilia (hairs) is found a gelatinous cupula into which the free ends of the

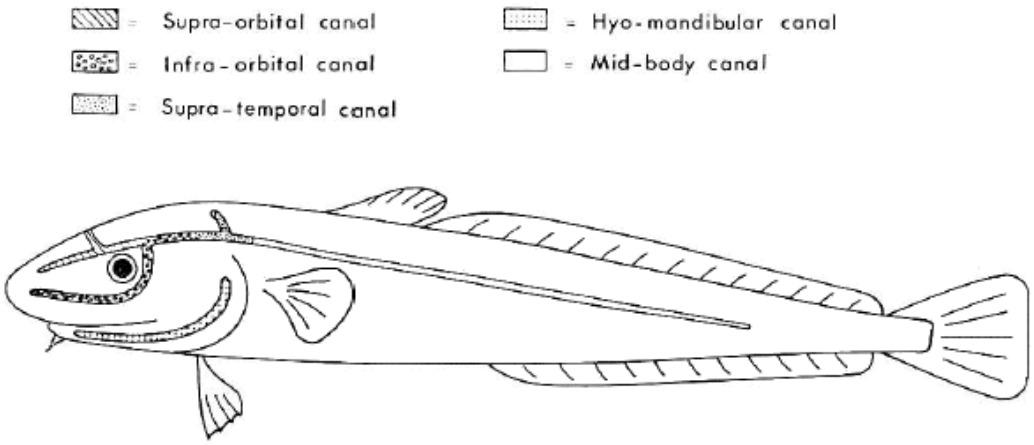

Fig. 1 - Lateral line canal of fish (Lota vulgaris). (Flock, Acta oto-laryngolog. 1965, Suppl. 199).

hairs are stuck. The cupula bends as a swing-door when the fluid in the canal moves forward or backward (Fig. 2).

Very likely the cilia from the beginning were mechanoreceptors sensitive only to vibration and touch. At any rate, they have vibratory sensitivity as a common feature throughout the line of development that we are tracing. In addition they have in the lateral line created a marked sensitivity to the direction of flow of the fluid inside the canal. Electron microscopy (Flock and Wersäll, 1962) has shown that this depends on the position of a special kind of hair, the kinocilium, longer and thicker than the others (the stereocilia). In some of these sense organs within the canal the kinocilia stand at the head end of the little group (Fig. 3), in others at the tail end and this also implies

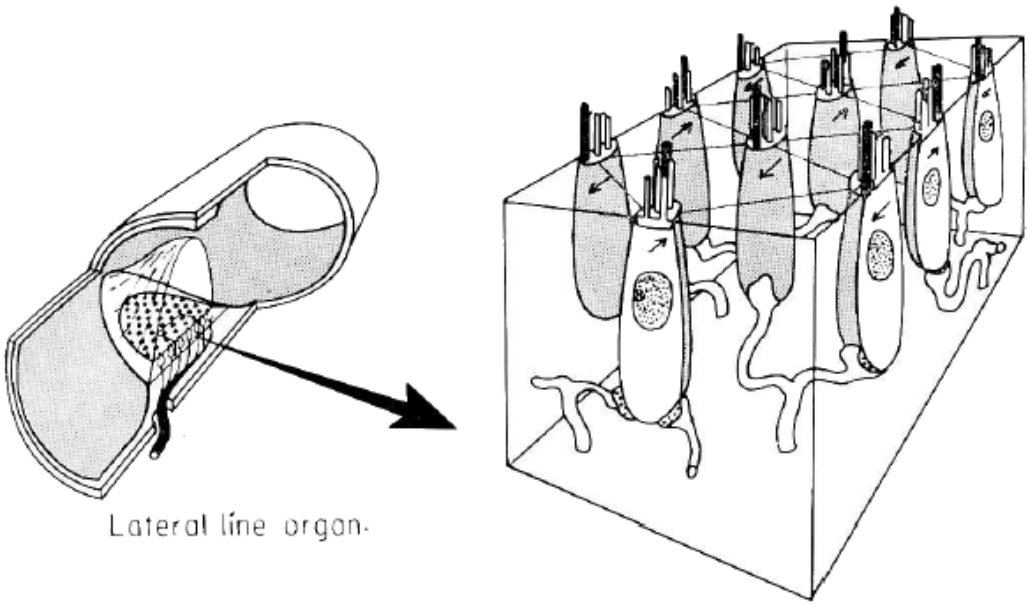

Fig. 2 - Inside lateral line are found sensory structures, the hair cells and their nerves, as illustrated, to the left with the gelatinous cupula suggested, to right highly magnified to show the two kinds of hairs (cilia), the kinocilia filled out, the stereocilia empty. Note that the kinocilia stand at either end of the hair cell and that hair cells with kinocilia at the same end are joined to the same nerve fibre. There will thus be nerve fibres responding to the movement of the fluid in two opposite directions. (Flock & Wersäll, J. cell. Biol., 1962, 15, 19).

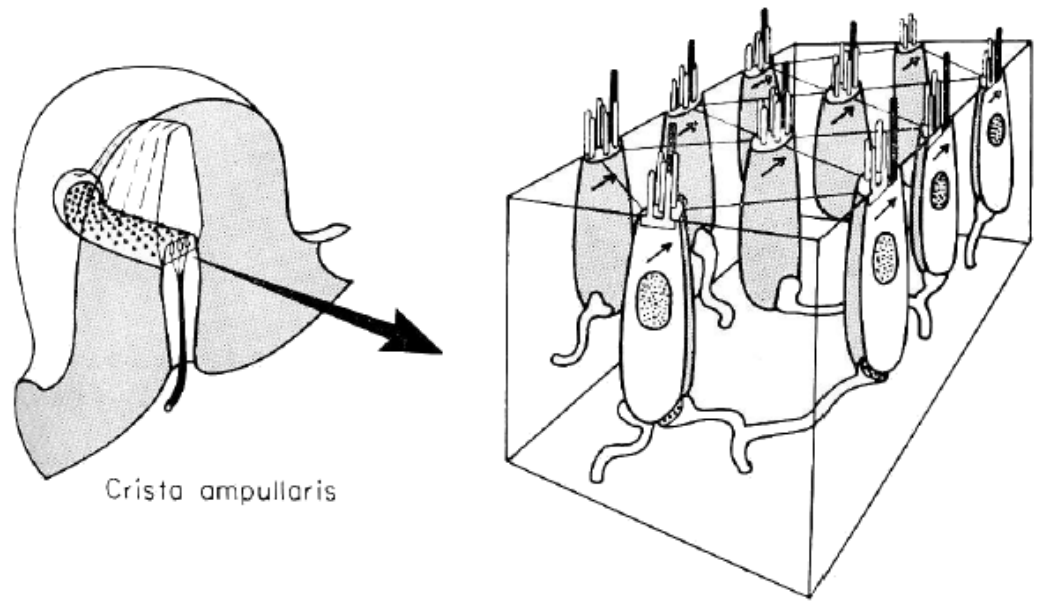

Fig. 3 - Left, cross-section of ampulla at the end of a semicircular canal. Hair cells sticking into the gelatinous cupula are shown in greater detail on the right. Compare with Fig. 2 and note that in this organ all the kinocilia stand at the same end of the cell. (Flock & Wersäll, J. cell Biol., 1962, 15, 19.)

a directional polarization of the receptors which respond with excitation when the fluid moves toward the kinocilium, with inhibition when it moves in the opposite direction. These observations explain the earlier findings of Sand (1937) that there are two kinds of receptors whose nerves behave as if they reproduced opposite directions of fluid movement in the canal by excitation and inhibition.

A further step in the evolution of these organs implies that some lateral-line canals on the head migrate into the bony structure beneath them while their ends close, the hair cells and the cupula move to one pole widened into an ampulla and the rest of the canal bends round to form a semicircular structure of which there are three, one for each plane in space (Fig. 4). This is the familiar picture of the three semi-

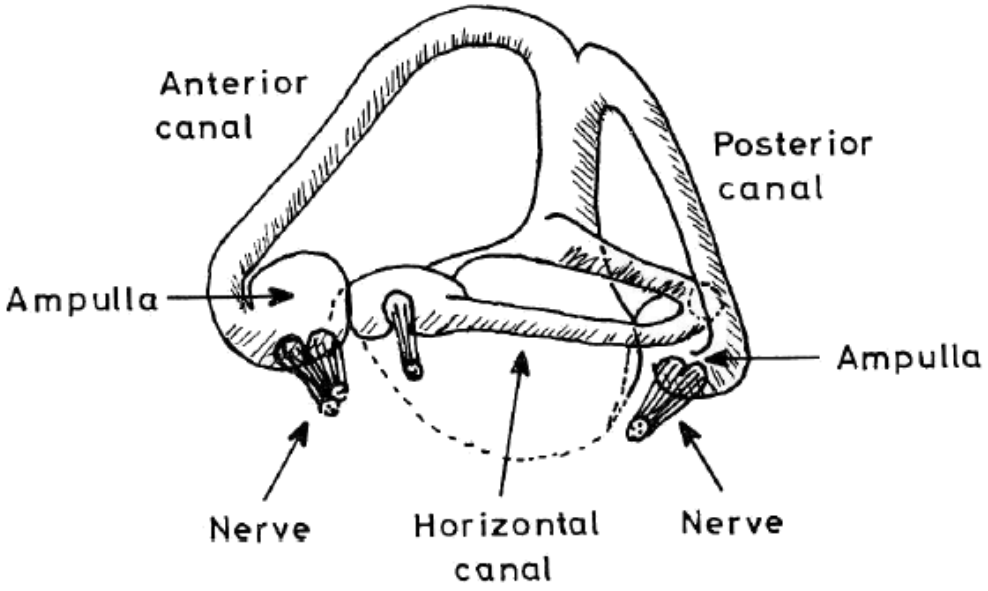

Fig. 4 - The semilunar canals in three planes end in ampullae containing the sense organs from which arise nerve fibres (schematic).

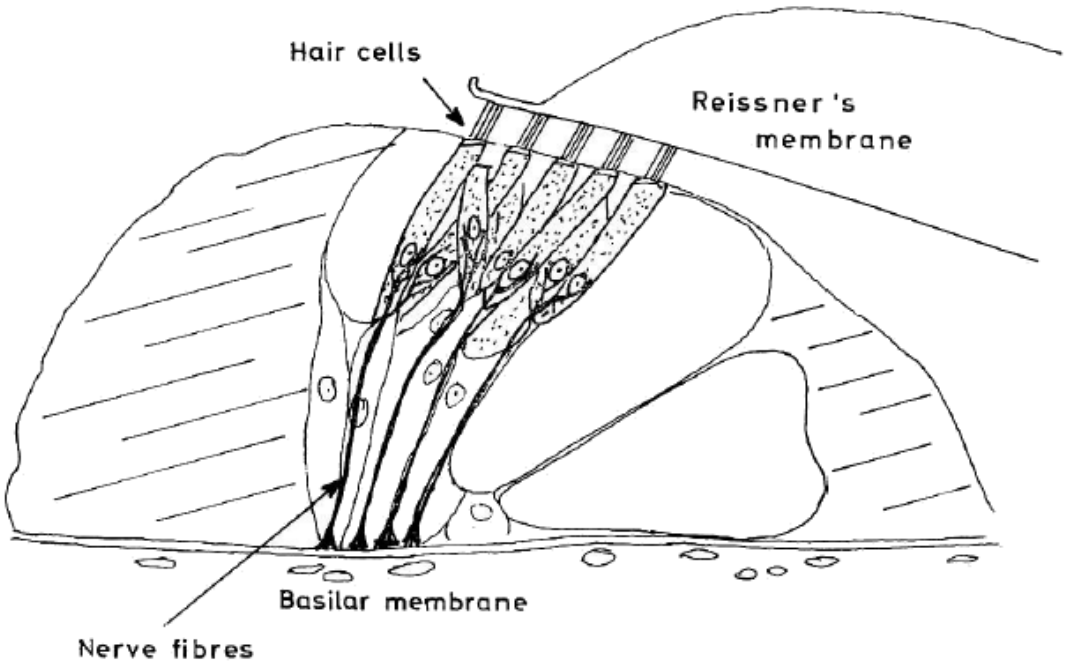

Fig. 5 - Schematic cross section of a winding in the organ of Corti illustrating hair cells, their nerves and the membrane of Reissner above them. The organ rides on the basilar membrane.

circular canals in the ear of all living species, from fishes upwards. All kinocilia are now within the ampulla and movement of the fluid toward the ampulla is excitatory, away from it, inhibitory. Such movement of the fluid in the closed canals will actually bend the cupula in proportion not to velocity but to the change of velocity or acceleration. Thus the semicircular canals are instruments for measuring angular acceleration. Other portions of the original lateral-line, that migrated into the bones of the head, have the shape of closed sacks; the three of them in fishes are known as sacculus, utriculus and lagena. The cupula has changed into a membrane and become loaded with small crystals, in fishes forming quite large conglomerates called otoliths. Because of the added weight, the hair cells beneath the loaded membrane will now be able to respond to gravity and hence to position of the head. All these transformations of the original lateral-line canal have been completed within the fishes. The organ inside the head rules our sense of balance and is generally known as the vestibularis.

When the animals leave the water, they need no lateral line any more but the semicircular canals and two of the loaded sacks (utriculus and sacculus) are as useful as before. From snakes onwards one of the sacks (the lagena) begins to wind itself into a spiral, gradually becoming a more and more perfect helix. In birds and mammals this line of development is complete and the end product is the cochlea or organ of hearing containing hair cells with a membrane above them but no otoliths (Fig. 5). Now evolution again makes use of the basic property of this structure which is to respond to vibration. This the lateral line did also, but in water the vibrations of a passing fish do not carry very far, whereas in air a recorder of vibration, further improved by the well-known mechanisms in the outer and middle ear, by its extreme sensitivity places the world of sound at our disposal.

This whole development would have been of little avail had not the rest of the nervous system kept pace with it and provided the various receptors with channels (nerve fibres) to the brain. Thus they have been able to profit from all the organizational advantages accruing from access to the supreme organ of control at several levels. This is where the white rabbit emerges out of the hat. One of the many miracles is that we develop musicality. There are those among us who are more musical than others and create great symphonies to the delight of some of their fellow beings. Looking at this talent as a development of the original tufts of hair of the acousticolateralis system adapting itself to environmental challenges, the creation of a symphony is an indefensible freak. It emerges as an extravagant by-product of the exceedingly useful gift of locating and identifying distant sounds. The same might be said about many other aspects of what is now our non-genetic cultural inheritance. If progress be defined as an increasingly perfect adaptation to the environment, and if, furthermore, the successive steps in evolution can be characterized by their survival value, musicality, religiosity, poetry etc. have no place in this order of things. (The existence of such unexpected terminations of a line of development makes one afraid of what euphenicists might strike if they were given a free hand to meddle with the great experiment of Nature's beyond the level of fairly harmless insemination).

Nothing suggests that we have a right to believe that our present minds as products of evolution as yet are fully exploited. To be sure, our brain has existed for a long time in its present shape and size; nevertheless the speech centre is likely to have been a fairly recent development. That half of the brain in which it is placed is called the dominant half. The other half is more primitive in its contact with our non-genetic inheritance, as the split-brain literature of the last ten years has shown. This literature has grown a great deal after it became possible to carry out the necessary brain surgery on well-defined indications (certain epilepsies). What about the silent half of the brain? Perhaps we are still half-Neanderthal with that side! Or perhaps, like sea lions in a circus, we need but be faced with entirely new situations to show unexpected new talents. This is speculation, not wholly unjustified.

But, joking apart, the whole world of non-genetic inheritance is clearly a challenge to all the evolutionary influences that I began by accepting. They are bound to change us, even if imperceptibly slowly. We are the first species capable of creating our own environment. Subject to forces of their own creation but outside their own control many species may have destroyed their own surroundings. Our advantage over the rest of the creation is that we possess a measure of freedom of choice, not enough to escape the laws of genetics, but perhaps sufficient to prevent the final destruction of our species. To have reached — in evolution — that level of privileged insight is indeed progress. The notion of a world-wide respon-

sibility for our role on this globe has been late in coming. In order to realize it we shall have to keep a close watch on the interactions between our genetical and non-genetical inheritance. Essentially, this is a task for the 'omnipotent scientific method' which is our most reliable instrument for producing the knowledge and environmental control required for survival. The idea of progress was a creation of science and so is the insight at which we have arrived, namely, that it is only possible to speak of progress as an adaptation to life on this globe, life in the widest sense considered as the environment to which we and other cellular organizations are matched.

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