

What is the psyche and how did it get into the world?

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The question

In this paper I will discuss what is for psychology the most fundamental of questions, namely, *what is the psyche?*¹ This is a question which Henrik Poulsen has been especially interested in, and which he and I have had a discussion about for years. This paper then is also a contribution to our ongoing discussion.

The problem

The central theme of the discussion can be presented best by quoting Aristotle who writes in *De Anima*: "Animate nature is thought to be different from the inanimate in two particulars, viz. in movement and sense-perception. And these, I may say, are the two traditional characteristics of the soul which we have received from earlier writers."²

Where there are two alternative characteristics, there arise two camps, each with its own viewpoint. In this case, one camp that holds "the view that the soul is a self-moving entity"³, and another camp that chooses, with respect to the psyche, to "emphasise the knowledge and perception of reality."⁴

Although our point of departure has been the Russian psychologist A.N. Leontiev and not thinkers of Antiquity, these were the positions that Henrik Poulsen and I had placed ourselves in. I stressed Leontiev's keyconcept of *activity* and emphasised the psychic as something conative, whereas Henrik Poulsen stressed Leontiev's keyconcept *reflection* and emphasised the psychic as something cognitive. The following quotation from Henrik Poulsen's article,

¹ The terms psyche and psychic in this article refers to the most simple and basic relation studied by the science of psychology. The terms mind and mental denotes according to the author's point of view a higher development of the psychic faculties and should be distinguished from the basic relation.

² Aristotle: *De Anima*, 404a 2. Cf. Hammond, 1902, p. 10.

³ Aristotle: *De Anima*, 406a 1. *Ibid.*, p. 18.

⁴ Aristotle: *De Anima*, 404b 10. *Ibid.*, p. 13.

"Leontiev, genspejlingsbegrebet og den almene psykologi" (Leontiev, the concept of reflectivity and general psychology) from 1982 states the case:

The concepts of reflectivity and activity are (as they must necessarily be) closely coupled together in Leontiev's theory. But it is reflectivity (cognition) and not activity that Leontiev has defined as psychology's object of study. This has troubled some of his readers, e.g. Engelsted, who would have preferred it if Leontiev had denoted man's conation, his striving, his actions, his activity as the object of psychological study. In my view though, Leontiev's judgement is correct.

The problem's special character is also illustrated by the fact that we both became convinced that the other was right. Thus, Henrik Poulsen shifted the emphasis in his position from the cognitive to the conative, as can be seen for example, from his important article on conations (Poulsen, 1986). Correspondingly, I realised the extent to which cognition and mentality are inextricably bound up with each other, and the argument could continue.

The legacy of modern psychology

The conflict concerning cognitive versus conative determination of mentality is a fundamental part of the legacy of modern psychology. If Wundt's establishment of the Psychophysics Laboratory in Leipzig in 1879 marks the birth of scientific psychology, then his two volumed work *Grundzüge der Physiologischen Psychologie* from 1873-74 marks the act of procreation. But in that case psychology had two fathers, for between Wundt's two volumes Brentano shipped in *Psychologie vom empirischen Standpunkte*. Thus the child acquired a split personality. For while Wundt emphasised the analysis of the cognitive content as psychology's task, Brentano emphasised the study of conative acts. If we also take into consideration the third claimant for paternity, the Russian physiologist Sechenov with his publication *Who must investigate the problems of psychology and how?* - also from 1873, then we have the principled positions that have been recurrent in psychology's development right up to today.

One can see that what is involved is a continuation of the fundamental philosophical problem of the simultaneous separation and connection of that which is subjective and that which is objective, which runs like a leitmotif through the whole of philosophy's history. Brentano, who is directly inspired by Aristotle, maintains the classical idealistic viewpoint that sees the subject (the psychic element) as actively determining the objective element ($S \Rightarrow O$), while Wundt and Sechenov maintain the classical materialistic viewpoint that sees the subject as being determined by the object ($O \Rightarrow S$). The difference between Wundt and Sechenov is that while the latter chooses to view the psy-

che from the outside, e.g. as something objective, the former chooses to view it from the inside, e.g. as something subjective.

It is not difficult to see that this is the kind of problem in which all parties possess a truth. The subjective and objective aspects need to be comprehended in one context, where the subjective aspect is simultaneously both determining and determined; where the mind or psyche is simultaneously both conative, as Brentano rightly claims, and cognitive, as Wundt rightly claims; and where Sechenov is also correct in asserting that the psyche must be understood as a fact in the objective, physical world and not as a world apart.

On the other hand, it is more difficult to find the solution that can make room for these different truths. It is, however, such a solution one is looking for when one asks - what actually is the psyche?

Psychogenesis

If one acknowledges that the psyche is a qualitatively new type of relation in the world, and that like other qualitatively different material relations (nuclear, atomic, chemical, biological, etc.), it is a product of the evolution of matter, then the question of what the psyche is can be tied together with the question of how the psyche came into the world?

In *Principles of Psychology* from 1855 Herbert Spencer expresses this insight by saying, "mind can be understood by showing how mind has evolved". Sechenov says the same with these words: "Scientific psychology and all its contents cannot be anything else than a series of teachings about the origin of psychic activity" (cf. Leontiev, 1978, p. 57).

With respect to our question, however, it is very important that a distinction is made between *evolution* and *origin*. One can study different specific mental manifestations, e.g. emotions, by examining the evolution of the psyche. But we ask: What is this psyche that evolves? Or what is psyche in general? To answer this question we must look at the first origin of the psyche in a world where there was not previously anything psychic. For as Klaus Holzkamp (Braun et al., 1983, p. 134) says, "*the earliest genetic form* must also be the most *general category*". This last point may be surprising, but it is very important to understand that the birth of the first member is also the birth of the whole category. A vast development separates the Wright brothers' first prototype from a modern Boeing 707, but the latter is no more an aeroplane than the former, the former no less than the latter. A molecule of protein is a world of complexity compared to a simple molecule of hydrogen, but still they share the essential nature of a molecule, i.e. the bond between electrons. In the same way, the mind of man may be eons away from the first psychic manifestations in the organic world, but still they must share the essential characteristics of psyche in general. Through all its specific evolutionary de-

velopments psyche remains what it was in the very first instance. This is the key to understanding what psyche is.

Continuity and discontinuity

This means that our own psyche's most general feature is a key to understanding what psyche is, and hence, to what the first psychic manifestation was. Not only is it possible, it is also necessary to infer from our own psychic experience to the most simple form of psychic life. If, for example, we are convinced that striving or conation is a general and essential aspect of our psychic life, we cannot deny simple psychic forms this aspect.

This concept does not invalidate Lloyd Morgan's Canon which forbids us to credit lower life forms with properties other than those that are necessary to explain their life-activity. It is an important methodological rule aimed at countering our tendency towards anthropomorphism, e.g. Darwin's attributing dogs with spiritual tendencies (Darwin, 1889, p. 95). It is also relevant in our present context where we view it as a demand for a precise distinction between the general and specific characteristics of psyche. Darwin's mistake was his generosity in letting the dog partake in specific human characteristics.

Darwin's lack of recognition of the psychic discontinuity between dog and man was, interestingly enough, due to his correct acknowledgement of the psychic continuity throughout the whole animal kingdom. Darwin namely believed that the one excluded the other. We will not complain, however, about his one-sidedness. It was the one-sided view of continuity (the classical canon *Natura non facit saltum*⁵ and the geological *uniformitarianism*) that aided in the birth of evolutionary theory.

Evolution, however, is always a unity of continuity and discontinuity; that which evolves simultaneously changes and remains. The psyche is the same as it has always been (continuity), according to the rule about the identity between the first and the general. And at the same time it evolves a sequence of qualitatively distinct levels (discontinuity) that, as Lloyd Morgan's Canon states, must not be mixed together. The two rules are therefore simultaneously applicable, and if they are contradictory then it is because development is essentially contradictory.

With the exception of some brilliant glimpses by a few individuals such as Heraclitos and Hegel, the dialectical synthesis of continuity and discontinuity, and thereby the conceptualisation of true development, has been beyond the reach of scientific thought prior to the advent of dialectical materialism. This has resulted in discontinuity being stressed at the expense of conti-

⁵ Nature makes no leap.

nunity, or continuity being stressed at the expense of discontinuity - with endless ensuing battles.

The conceptualisation of psyche requires the simultaneous presence of both continuity and discontinuity; or, expressed in evolutionary terms: Mentality is simultaneously both a continuation of the physical world with which it is congruous, and the expression of a qualitatively different non-reducible principle. Both parts are necessary since psyche is true to the physical world as well as to itself.

Sharing their common world, however, never seemed to be an easy matter for the psychic and the physical. At least not if you judge from the battle of the sciences.

Change of guard

The paradigm shift from Aristotelian to Galileian thought that occurred around year 1600, and which we connect with the birth of the modern natural sciences, could, of course, only be accepted by the natural historians with difficulty. One was willing to accept that falling stones and orbiting planets could be better explained in terms of external mechanical forces, but the concept of teleological⁶ striving was still held to be valid for living forms.

Thus the English natural historian John Ray protested against the natural sciences' replacement of the old teleological explanatory principles with new mechanical ones, and wrote that "these mechanic philosophers being in no way able to give account thereof from the necessary Motion of Matter, unguided by Mind of Ends, prudently therefore break off their system, when they should come to animals" (Ray, 1701, p. 48.).

Naturally he should not have done this. His colleague in the newly founded *Royal Society*, the physicist and chemist Robert Boyle, who was England's leading advocate for introducing the new mechanical explanatory system in science, replied that he "that knows the structure and other mechanical affections of a watch, will be able by them to explicate the phaenomena of it, without supposing that it has a soul or life to be the internal principle of its notions or operations." "While he who does not understand the mechanics of a watch may believe as those of China did when the Jesuits first brought watches

⁶ The term teleological is used in this paper to denote descriptions or explanations in which notions concerning an intention form a part, that is, where events or acts of behaviour are carried out with reference to some future situation, goal or end; i.e. where the nature of the end in some sense and degree plays a part in determining or governing the course of those events or acts of behaviour. In contrast, mechanical explanations refer here to the opposite, i.e. events and behaviours which are determined according to some past or present situation. This distinction is in line with the two different types of causality named by Aristotle as *causa finalis* and *causa efficiens*, respectively.

thither, that a watch is an European animal, or living body, and endowed with a soul" (Cf. Le van Baumer, 1978, p. 315). Which implies that when Ray believes that a psyche or a teleological principle is necessary in any explanation of a living organism, it is because in his ignorance he has not grasped that a living creature is completely explainable in the same way as the watch is - in terms of mechanical motion between the elements that the organism is composed of.

Thus, the living organism became a machine, in which the mental aspect, in the words of the French doctor and materialist LaMettrie (1748), is merely a question of "a few more wheels, a few more springs", for as he further writes - "all the faculties of the soul depend to such a degree on the proper organisation of the brain and of the whole body that apparently they are but this organisation itself".

It is to their credit that the natural historians did not give up. To deny the living organism's purposive striving was to deny the evident. If the organism was a mechanical machine, then there at least resided a special life-force⁷ in it, which was not to be found in inanimate forms.

That mechanism breeds vitalism is inevitable. One half-truth must call forth the denied opposite half-truth with a vengeance. The conflict can only be settled by bringing the realities and the interconnection of the objective and the subjective together in a unifying theory, and this is only possible with an evolutionary theory. Such a theory has in effect been formulated by the brilliant natural scientist Jean Baptiste Lamarck at the end of the 18th and the beginning of the 19th century. It drowned, however, in the counter revolutionary events in France and has since been grotesquely misrepresented. The whims of history thus denied the coming scientific psychology a very ideal starting point, and it had to set off from the more primitive problem defined by the conflict of mechanism and vitalism.

The pact of the four students

One of the founding fathers of experimental physiology was Johannes Müller in Berlin, who's name is tied to the discovery of the specific forms of sensory energy, e.g. the fact that the quality of sense perception (i.e. sound or light) is dependent on the stimulated nerve and not the nature of the stimulus. Consistent with the vitalistic tendency of German Romanticism Müller referred this to spiritual forces in the body which so upset four brilliant students of his that

⁷ This life-force has in the course of time had many names, e.g. the entelechia of Aristotle, the pneuma of Galenos, the archeus of Paracelsus, the moule interne of Buffon, the vis essentialis of Wolff, the Lebenskraft of Johannes Müller, and later the élan vital of Bergson and the entelechi or psychoid of Driesch.

they formed a pact in 1845 swearing never to budge from the conviction that "no other forces than common physical chemical ones are active within the organism" (Boring, 1950, p. 708).

The four students were von Helmholtz, du Bois-Reymond, Carl Ludwig, and Ernst Brücke, and their students were the founders of scientific psychology. Wundt studied with Müller, next with von Helmholtz and du Bois-Reymond. Sechenov studied with Müller, and then with du Bois-Reymond and Carl Ludwig. Ernst Brücke had a no less famous pupil, young Sigmund Freud in Vienna. In this way the pact itself became the point of departure for scientific psychology, the task of which became the conceptualisation of psychological phenomena without reference to vitalistic or spiritual forces, i.e. forces of a non-physical nature.

This programme is still valid. If we are to answer the question of what psyche is, we must strictly adhere to the letter and spirit of the pact.

This does not mean that psyche is *nothing but* the principles generated by physiology. Psyche is a set of principles in its own right and cannot - despite Sechenov's brave efforts - be reduced to physical principles as studied by physiology.

The timeless identification of psyche

What is it then that sets psychic phenomena apart from physical ones? It is the contention of this paper that this has basically been known through all history. Only the conceptual systems have varied according to ideology and scientific insight, i.e. to the productive relations and productive forces. The essence of the psyche cannot be unknown to reflecting mental beings such as ourselves. It is precisely the phenomena of cognition and conation as Aristotle wrote in the first treatise on the psyche.

In the chapter in *Psychologie vom empirischen Standpunkte* dealing with the difference between that which is psychic and that which is physical Brentano points precisely to Aristotle and writes: "In his treatise on the soul he says that that which is sensed as such is in him who senses; that the sense (mind, psyche) registers that which is sensed without (its underlaying) matter" (Brentano, 1874). Thus, Brentano emphasises the ideal character of cognitions. The form of the material object is reflected by the knower in an ideal form (where the object exists without really existing), and this dual existence of the object (as material and ideal entity) is cognition.

Ideality as content is, however, insufficient as a definition of mentality. According to Brentano the psychic aspect is fundamentally an act: "Every psychic phenomenon is characterised by that which the Scholastics of the Middle

Ages have called the intentional (or mental) -inexistence⁸ of an object, and which we, in somewhat ambiguous terms would call the reference to a content, the direction toward an object ..., or an immanent objectivity. Every (psychic phenomenon) contains something as its object, but not every psychic phenomenon does so in the same manner. In presentation, something is presented; in judgement, something is affirmed or denied; in love, something is loved; in desire, something is desired and so on" (ibid.).

With these concepts Brentano emphasises the anticipatory nature of that which is psychic. Immanent objectivity or intentional inexistence implies that the object must ideally exist in the act before it can be brought into existence. What is meant is an orientation towards an object in the world, a future goal, i.e. a purposive act.

This fusion of the cognitive and conative (striving) elements in an intentional anticipation is the essence of the psyche. Brentano writes: "This intentional inexistence is exclusively characteristic of mental phenomena. No physical phenomenon manifests anything similar. Thus, we can define mental phenomena by saying that they are such phenomena as include an object intentionally within themselves" (ibid.).

The Soviet psychologists Davydov and Zinchenko attest to this with the following quotation from an anonymous classic source "about the nature of the mind (soul) that gets to the very essence of the problem", as they put it. The quotation reads: "If you do not know what you are looking for, then why are you looking; if you know what you are looking for, then why are you looking for it?"

Davydov and Zinchenko continue: "This fundamental contradiction is the true source of the development of the mind of animals and man. Psychology as a science itself develops by advancing the development of concepts that enable it, in one way or another, to reveal the possibility of resolving this contradiction. To look for something that does not yet exist but that is possible and is presented to the subject only as a goal, something that exists as an idea and is not yet actual: this is the fundamental, cardinal aspect of the vital activity of every sentient being - a subject" (Davydov & Zinchenko, 1981, p. 24).

We change Brentano's, Davydov's and Zinchenko's words into our own. The intentional inexistence of the object in the activity of the subject is the general characteristic of the psyche in all its forms, i.e. also in the very first form. This is the same as saying that that which is psychic is a teleological principle (cf note 6). Psyche and teleology refer quite simply to the same thing.

⁸ The term inexistence here has the double meaning of material non-existence of the object in the mental act and yet the object's actual existence in the intention, NE.

To explain how this phenomenon arrives in the world without offending the pact of four is the fundamental task of defining the psyche.

The decisive importance of an evolutionary theory

The fact of the psyche was not unrecognised by the pioneering physiologists. It is not without cause that psychology was spawned from their work and teaching. Müller's bright students probably never felt sure that the old man's famous dictum - *Nemo psychologus nisi physiologus*⁹ - might not read equally well both ways. When they rejected the helping hand of vitalism, and herein lay their scientific significance, it was impossible for them at the same time to bridge the principles of physics and physiology and the fact of psychic phenomena. They had understood that if one was not able to explain mentality on the materialistic basis of physics and chemistry, then one could not explain it at all. But at the same time it appeared so hopelessly impossible to acknowledge that which is psychic as a genuine, irreducible principle, that du Bois-Reymond in his *Seven Riddles of the World* from 1882 counted it as one of the seven (in effect three of the seven) fundamental enigmas which science had to give up on. Sechenov's resolute reductionism and Wundt's lame psychophysical parallelism did not disprove this point.

The problem was then a dialectical one concerning the simultaneous connection and separation of that which is subjective and that which is objective, which is only comprehensible with a theory of development. The pioneers did not possess such a theory and the problem of the psyche was therefore an unsolvable puzzle. Darwin's theory, when it eventually arrived, was not of much help either. All things considered, a theory of natural selection is not a theory of development.

There is therefore, not least because of this, reason to regret that Lamarck's work was so unrecognised. Half a century before the pact of four he had formulated precisely the same rejection of vitalism: "The laws that rule all those mutations we observe in nature are always the same and never in mutual contradiction; yet they produce in the living bodies results which are vastly different from those occasioned in the bodies lacking life and which are their opposite altogether." Or, put another way, it is the same laws, e.g. the known physical laws, which apply to living as well as non-living bodies. Thus, no "arché-vitale" or vitalistic principle of life exists. This is so, even though the living follows a completely opposite principle to the non-living (Lamarck, 1830, vol. 2, p. 91-94).

Lamarck talks here of the living and not of the psychic. It is very important to distinguish between these two, but for Lamarck the problem of life and the

⁹ No psychologist who is not a physiologist.

problem of the psyche were interconnected, as they have been for most biological theorists from Aristotle to today. This, as such, is not a false idea, the comprehension of the psyche is inseparable from the comprehension of life and its development.

One of the world's mysteries that according to du Bois-Reymond fell beyond the reach of science was the origins of life. But it was not an impossible problem for Lamarck. The Jacobine revolution in 1793 had presented a professorship in invertebrate zoology to the 50 year old botanist from the Royal Gardens, and his classificatory labours in this huge virgin territory forced the concept of evolution upon him. Lamarck worked with this problem on what was according to the conditions of the time, a truly scientific basis until his death in 1829. The counter-revolution subdued his work, but could not halt the old man.

The interconnection of the sciences

Lamarck had understood the very principle of development, i.e. the simultaneity of discontinuity and continuity. A new stage in the development of matter represents its own unique features, but at the same time it is born from the principles of the preceding stage and cannot be in violation of these principles. Life is qualitatively different from chemistry and physics, but it must be brought into existence by the forces of chemistry and physics.

The same applies for the subject matter of the other natural sciences. The laws of chemistry, for example, are the special characteristics of the molecular bond between electrons in atoms. Chemistry as a science *presupposes* the existence of this relation and cannot therefore explain how it came into being. Only the science studying the preceding level of material organisation can do this, i.e. the science studying the principles of atoms. The autonomy and interconnectedness of the sciences thus reflect the discontinuity and continuity of material development.

This is also the case with psychology, whose object - the psyche - is a completely new quality in the world. The laws of this new quality can and should be studied by psychology, but psychology cannot itself (e.g. within its own subject area) explain how the psyche as a new quality came into being.

If we undertake for the sake of illustration the traditional Cartesian division and talk about the physical principle and the psychic principle, then it will tell us that the coming into being of psychology's object occurs in physics's subject area and in accordance with the laws of the physical world.

Here we have in addition the simple reason as to why psychology has had so much difficulty in - not understanding - but conceiving that which is psychic; namely, the immaturity of physics, and not psychology, as a science. For as long as physics has not cultivated the ground from which the psyche, as a new

quality, shoots up, the conceptualisation (but not the description) of that which is psychic has been beyond the reach of psychology. For as long as physics is only able to model the permutations of complex, macroscopic matter as the workings of simple machines, the psyche must haunt the premises as a ghost.

Lamarck's modern insight

Lamarck understood this and in the formulation of the qualitative difference between animate and inanimate matter he is strikingly modern. Lamarck points out that the fundamental tendency in inanimate matter is that which William Thomson formulated half a century later as the second law of thermodynamics¹⁰, which states that growing *entropy* is the law of time. In contrast, the characteristic tendency of animate matter is that the processes involved result in higher organisation and greater complexity, i.e. travel in a negative entropic direction (Lamarck, op.cit.).

Does this mean that that which is living falls beyond the laws of physics? Yes, in the sense that living matter travels counter to the natural direction of thermodynamics. But this happens only by virtue of the same physical laws. And if this sounds contradictory, then it is no more so than the fact that the sailing boats in the Bay of Aarhus are able to beat to windward, but only by virtue of the wind.

In any case, Lamarck maintains in this contrast the principle of materialism in that he says, "every fact or phenomenon observed in a living body is, at one and the same time, a physical fact or phenomenon and a product of organisation" (Lamarck, 1815-22). But organisation is something other and more than LaMettrie's mechanical composition; the secret of life must be sought in a special context or process. The living body is "toujours actif", and it is in the *organised activity* that we will find life's distinctive feature. Today this is a fashionable acknowledgement. During Lamarck's time, where living organisms were explained as spirits or watches, it was, of course, far ahead of its time. Take, for example, Lamarck's description of how life, as a special form of material organisation, could spontaneously arise by virtue of known physical laws and the effect of common physical agents. Here he mentions "l'air atmosphérique, différencé gaz, l'eau, [...] le calorique, l'électricité" (Lamarck, 1830, p. 85) and asks "why should not heat and electricity act on certain matters under favourable conditions and circumstances?" (Lamarck, 1802).

Why not indeed? A decisive breakthrough for science on the matter of the beginning of life was, of course, Stanley Miller's experiment in 1952 which

¹⁰ The first law of thermodynamics - the law of the constancy of energy - was formulated by von Helmholtz in 1847, i.e. as a direct continuation of the pact of four.

demonstrated that organismic macromolecular structures which are the prerequisite for life, could be spontaneously formed when electric sparks are sent through a water-based solution of ammonia, methane and hydrogen; i.e. under experimental conditions designed to correspond to the conditions on our planet in its infancy. This - and later studies that used other substance combinations and sources of energy - can be seen as the experimental affirmation of Lamarck's hypothesis, that "by means of heat, light, electricity and humidity nature forms spontaneous or immediate generations at the extreme of each realm of living bodies where the simplest of bodies are to be found" (Lamarck, 1830, p. 80).

What is life?

The spontaneous self-organising ability of nature which Lamarck drew attention to, is the big breakthrough area in modern physics, which has consequently, on the basis of thermodynamics, cybernetics, information theory, bio-chemistry and ecology, and through conceptions such as Prigogine's dissipative structures¹¹, Eigen's hypercycle and Mandelbrot's chaos - to name but a few - brought complex material organisation, and thereby life, within the secure reach of science.

But at the same time as modern macroscopic physics begins to offer physical principles for the comprehension of the preconditions of life, the problem of distinguishing between these principles and life in itself arises as a specific problem. Life is spontaneous material self-organisation, as Lamarck saw, but self-organisation in itself is not life. Non-living material systems share this ability to establish order against entropy when they receive and dissipate energy, as Prigogine has recently demonstrated, and as Schrödinger already pointed out in the famous treatise *What is Life?* in 1944. In the same way life is without exception a self-replicative phenomenon, but replication in itself is not life. Many non-living material systems replicate. The shadow of the central dogma, however, here seems to obscure our understanding of life.

The physicist Freeman Dyson has specifically tackled this problem in *Origin of Life* from 1985. In his critique of Schrödinger and others he insists upon the distinction between replication and metabolism, and suggests that life has had two beginnings. First in the form of metabolism and hereafter as metabolism and replication, in that cells with metabolism have entered into a symbiosis with replicative structures. In support of this view, Dyson states that there actually exist forms of matter that possess the property of genetic replication without metabolism, namely viruses, which as is well known live as parasites on other living cells. And there are probably also forms of life that

¹¹ See Jens Mammen's paper in this volume.

possess the property of metabolism without genetic replication, namely, the so-called prions which cause disease in sheep and supposedly are proteins without nucleic acid.

By accounting life's first beginning to metabolism Dyson has also made metabolism the defining feature of life. In this I believe him to be right (Engelsted, 1981, p. 105-112), but the essential characteristic of metabolism can be given a more general formulation.

The principle of life

The precondition for spontaneous self-organisation is the inflow of energy. That which distinguishes living systems from non-living ones is the fact that the former control this inflow. In their first Oparin-like forms they are monads, but monads with windows and like Maxwell's demon they can open and close these windows. This self-active moment distinguishes metabolism (and thus life) from mere exchange.

In a philosophical sense the living system thus is a subject, as biological thinkers since Aristotle have acknowledged. But this does not go beyond the facts of physics, and only means that the living system has access to its own sources of energy, which, of course, all known living forms from bacteria to man have in the form of cellular ATP.

The expenditure of energy as the precondition for the intake of energy - food - is the defining characteristic of life. Life must break down its own order to be able to build up its own order. (Of course, the investment must be profitable for life to succeed.) Life is thus a realisation of the general thermodynamic principles where dissipation of order makes possible the opposite negative entropic movement. But it is a particular realisation, and the particularity is the subjectness of the living system.

The definition is not, however, hereby complete. Just as a subject cannot be comprehended in isolation from its object, a living organism cannot be comprehended in isolation from its external sources of energy. If life is the ability to feed through the expenditure of its own energy on an external stream of energy, one cannot exclude the latter part from the definition. One cannot exclude sugar from the definition of yeast, yeast would not be without sugar. Sugar is the *other-being* of yeast, as Hegel would say. Life is thus a relation, and if you - *in-vitro*-wise - cut off the organism from this relation, it becomes incomprehensible.

The principal definition of the phenomenon of life may therefore be expressed in subject-object terms in the following way. Life is a relation in which the one side actively (spending of energy) relates to the other side, which houses the first side's conditions of existence (as a source of potential energy).

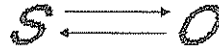


Fig. 1

The formulation of the general principle of life is not in itself a concrete scientific description of life's relation. For this purpose one requires the concrete physical, chemical, biochemical, cosmological, biogenetic and ecological studies that are presently beginning to open the door to the phenomenon of life.

Neither does the principle of life in itself say anything about the particular problem of behaviour, i.e. the principles that guide the monadic organism into opening and closing its window. Behaviour, of course, can only be understood against the background defined by the principles of life, but it cannot be identified with these principles. How the monad communicates with the world outside is a problem in its own right, and it is somewhere in this context that the phenomena of the psyche come into existence.

Stimulus-response

The fundamental concept in the study of behaviour has for several reasons been *stimulus-response* ($S \Rightarrow R$). Firstly, it springs from the philosophical paradigm of Galileian natural science emphasising cause and effect relationships of a mechanical nature. Secondly, it readily offers itself to experimental procedure, where effects are understood as the product of initial conditions under the control of the experimenter. Thirdly, it is a true reflection of a broad range of biological phenomena.

In our metaphor, stimulus-response means that first something taps on the window of the organism, after which the organism opens the window. The causal relation - initial event - secondary event - is very different, however, from ordinary mechanical causality. When you kick a ball the energy from the kick is transferred to the ball and makes it fly, but it is not the energy from the tap that opens the window. The stimulus and the response have no energetic correspondence. The organism itself opens the window, through energy of its own, and does so according to the information and not the energy of the stimulus.

The responsiveness of the organism is thus a reflection of the general principle of life. In biology it is called *irritability* - defined by Leontiev "as the general property of all living bodies to enter into a state of activity through the effect of external influences" (Leontiev, 1981, p. 13).

The stimulus-response sequence involves two sets of control which should not be confused. The stimulus is in control because it causes the organism to act. The organism is in control because the response is its own doing. In the latter aspect the organism is fundamentally active. In the former it is passive, the initiative belonging to the stimulating agent. To express this double determination we will call the responding organism for *re-active*.

The prototype of this reactivity is the sequence: (1) Contact with an object of food stimulates the organism (2) into an active response devouring the object of food, (3) which subsequently is consumed furnishing the organism with life-sustaining energy.

The middle term unavoidably introduces the concept of purpose, which is an anathema to the mechanical paradigm. The organism does something (2) to achieve something (3). That events or acts of behaviour are carried out with reference to some future situation is certainly the case here, thus the spectre of teleology arises.

The behavioural scientists have not evaded the issue, however. In nearly all texts on behaviour one finds arguments trying to circumvent the problem of teleology; and with no little success, as it proves.

Intention, function, and teleonomy

A noteworthy effort to refute teleological explanations is coinciding with the birth of a new science - cybernetics. Norbert Wiener's efforts during World War 2 to make British anti-aircraft guns goal-directed proved to his mind that goal-directedness fits fine with mechanics. Teleology is just negative feedback, he declared in 1943 together with Rosenblueth and Bigelow (Wiener, Rosenblueth & Bigelow, 1943). The same conclusion had been reached by W.R. Ashby: "The property of being 'goal-seeking' is not that of Life or Mind but of negative feedback (Ashby, 1948). Would anyone question his evidence, then a machine named 'Homeostat', designed to imitate certain features of behaviour, and Walter Grey's "Machine Speculatrix" complete with motor, wheels, photo-electric receptors and 6-volt accumulator, would end all doubt.

The identification of life with negative feedback is erroneous, but the point about behaviour is not. The behaviour of the mechanical beetle, tortoise, or whatever is goal-directed, but it would be wrong to say that the robots have an intention. The purposiveness is a result of the design.

Here we can straight away see one of the argument's weaknesses. The mechanical animal had no intention, but its maker did. The issue of teleology is not refuted, only displaced.

This displacement is curiously reminiscent of pre-darwinian deism, which related the wonderfully adapted design of living nature to the providence of the Maker. The question to be answered, though, is how does one account for the seeming purposefulness of nature as a *natural* and not as an *artificial* phenomenon?

The efforts of cybernetics and deism have not been in vain, however. From the distinction between designer and design springs, the distinction between *intention* and *function*. The goal-seeking behaviour of the mechanical beetle is a function laid down in the design; the device has no intention. In the same way the gyration of the bean stalk is a function laid down in the design, and not an intention. The robot and the plant are goal-directed, but they are not in a true sense goal-intending. The goal-directed functionality of the artificial creature is easily accounted for - its designer intended it to behave in a purposeful way. But who designed the beautiful goal-directed functionality of the bean stalk? The answer, of course, is natural selection. There is no conscious aim of a designer in nature; the functional design of living organisms is the result of random variation and subsequent selection of the more functional designs, i.e. those with better life success. To explain the functionality of the bean stalk therefore requires the tracing of its concrete evolutionary history. What seems to be teleology is only adaptability, as Ashby says, and adaptability can be understood in terms of ordinary causality.

To distinguish the functional goal-directedness of all living organisms from the concept of genuine teleology, where a future situation is intended, Pittendrigh (1958) has suggested the term *teleonomy*, which can be defined as a planned activity that functions in a goal-directed way without knowledge of the goal. Teleonomy is thus "pseudo-purposeful functioning" (Luria, 1973, p. 80).

Three kinds of explanation

The concept of teleonomy expresses the complexity and historical nature of biological phenomena. In physical mechanics there is a direct and immediate connection between cause and effect, but the response of the living organism is not directly explainable from the stimulus that prompts it into action. H.S. Jennings formulates this in the following way in *Behaviour of the Lower Organisms*: "The reactions produced in unicellular organisms by stimuli are not the direct physical or chemical efforts of the agents acting upon them, but are indirect reactions, produced through the release of certain forces already present in the organisms" (Jennings, 1962, p. 261). The response therefore must be

understood in terms of the design of the organism, and this again in terms of evolutionary history. Stimulus-response, seemingly a simple causal relationship, is thus a very complex one, which is only comprehensible from the perspective of relations beyond the immediate situation. Biology therefore has to distinguish between different levels of explanation.

Fraenkel and Gunn (1961, p. 16), in their classic study of animal orientation, specifically take this problem up in connection with the discussion of teleological explanations in biology.

They choose as an example the behaviour of woodlice. Woodlice aggregate in damp places, which is extremely appropriate considering that they desiccate in dry surroundings. The explanation that comes most immediately to mind is, therefore, that woodlice search for moist places with the intended aim of securing their lives.

However, this clearly teleological explanation gives the student of invertebrate behaviour plenty to think about. How do woodlice know the future situation? How can they aim for something not present?

They do not, as the scientific study of their behaviour proves. Through the mechanism of stimulus and response, the woodlice react to the immediate situation. They respond to the stimulus of dryness by speeding up their movement. The movement has no aim, it is not directed towards anything. Moving speedily in dry surroundings and slowly in moist nevertheless means that woodlice, all else being equal, spend more time in the preferable conditions. The aggregation thus follows from ecological laws of probability and does not even involve goal-directedness on the part of the animal.

This simple locomotive behaviour, *kinesis* in the language of invertebrate zoology, which actually orients the animal toward optimal conditions, but without any real orientation at all, is a perfect expression of the beauty of teleonomy.

Fraenkel and Gunn call the explanation expressed in terms of stimulus-response connections "the mechanical answer". We would call it the functional answer, and it still leaves unanswered how the function came about. This calls for "the evolutionary answer", as Fraenkel and Gunn rightly say, and they further point out that both the mechanical and the evolutionary answer are valid and belong together.

The teleological answer, however, is non-valid. At best it is an antropomorphism used for reasons of convenience and easy expression. The answer, that the organism does this with the aim of achieving that, should only be used as a sort of short-hand for the full evolutionary and functional explanation, which would be too cumbersome to repeat at every instance.

Evolutionary short-cuts

However, it is evident that human communication is not the only area in which it is expedient to short-cut the lengthy and complex workings of natural selection. It has happened in evolution itself. The adaptation of animal behaviour is not only determined by natural selection, i.e., on the level of species and of population genetics. It is also determined on the level of the individual. Learning, the individual ability to adapt behaviour to changing circumstances known in all animal forms, is a true short-cut of natural selection (favoured by natural selection, actually).

This does not mean that learning transgresses the bounds of teleonomy. The adaptability of the stimulus-response sequence known as classical and operant conditioning, for example, is in very nice agreement with the concept of teleonomy. But it means, that life is on the look out for advantageous short-cuts on the individual level. Behaviour guided by true intentionality would undoubtedly be such an advantageous short-cut, if developed.

Whether it has developed or not cannot be decided from philosophy, logic or the current concepts of natural science. It is solely an empirical question. As such it must be answered in the affirmative. Man has true intentionality, as described above by Brentano, Davydov and Zinchenko. True intentionality thus exists in the real world. This has been called psyche throughout the history of thought and its special quality is precisely the teleological, i.e. the genuine reference to a future situation or goal. The sole question, therefore, is how teleology came to exist in the teleonomic world of natural selection?

From irritability to sensibility

Lamarck recognized the importance of this question, for - as he writes in *Philosophie Zoologique* from 1809, "if nature were confined to the employment of its first means - namely, of a force entirely external and foreign to the animal - its works would have remained very incomplete; the animals would have remained machines totally passive" (cf Packard, 1901, p. 329)¹². They are, however, not machines which is why a transformation must have occurred during the course of evolution from teleonomical irritability to a proper form of subjectivity. We can imagine, writes Lamarck, "how the force which excites the organic movements may, in the simplest animals, be outside of them and yet animate them; how, then, this force has been transported and fixed in the animal itself; finally, how it then has become the source of sensibility, and in the end of acts of intelligence" (ibid., p. 281). The subjective sensibility which

¹² Corrected from the original by the author.

develops from simple irritability "constitutes this me (moi) with which all animals, which are only sensitive, are penetrated, without perceiving it, but which those possessing a brain are able to notice..." (ibid., p. 325). But Lamarck concedes that this "feeling of existence (sentiment d'existence), which I shall call *inner feeling*, ... is a very obscure feeling" (ibid.).

A very obscure concept also, we should add. Lamarck has not solved the problem, only identified it. The identification, however, is a magnificent achievement. The key to understanding the psyche is the transformation of irritability into sensibility.

This is also precisely how A.N. Leontiev understands it. In his doctoral dissertation from 1940 on *The problem of the origin of sensation*, he writes that "from the angle of our hypothesis, sensitivity arises as a rudimentary form of psychic reflection, during the evolution of simple irritability that is inherent in any viable body, even the simplest" (Leontiev, 1981, p. 51). Then he immediately makes it clear "that our hypothesis rejects from the start any attempt to approach reflection from the angle of the notorious 'principle of the specific energy of the sense organs' (J. Müller)" (ibid.). In other words, the explanation of how this primitive psyche comes into being must live in accordance with the pact of four. This does not mean, however, that the specific quality of psyche can be reduced away. "Mind is a property of living, highly organised material bodies that consists in their ability to reflect in subjective experiencing the reality around them, which exists independently of them" (ibid., p. 18).¹⁸

Subjective experiencing amounts to no more than Lamarck's inner feeling, it is merely an identification of the phenomenon to be explained. This is important enough, but the interesting thing is, how Leontiev conceives the transformation of irritability into sensibility and how this relates to his general theory of activity.

Theory of activity

The theory of activity is an unique attempt to overcome the chasm between the classical materialistic stance emphasising one-sidedly the objective determination, hence the cognitive content or the known ($O = > S$), and the classical idealistic stance emphasising one-sidedly the subjective determination, hence the conative or the act of the knower ($S = > O$). It is thus an attempt to apply within the field of general psychology the insights of dialectical materialism, which was born from the problem of the subjective and the objective.

¹⁸ Corrected from the German translation.

In the very first of the *Theses on Feuerbach*, with which Karl Marx in 1845 embarks upon his monumental scientific-philosophical undertaking, he writes: "The chief defect of all previous materialism is that things, reality, sensuousness are conceived only in the form of the *object*, or of *contemplation*, but not as *sensuous human activity, practice*, not subjectively. Hence, in contradistinction to materialism, the *active* side, was set forth abstractly by idealism, - which, of course, does not know real, sensuous activity as such" (Marx & Engels, 1976, p. 615). Therefore the necessity of a new concept of materialism able to encompass the facts of real subjective activity in a real objective world.

This insight was not wasted on the young Soviet psychology, led by inspired Vygotsky it set out to remedy the inability of Feuerbach to "conceive human activity itself as *objective* activity" (ibid.).

Naturally, man was the first priority of the Cultural-historical School of Vygotsky and his team. In particular, ontogenetic studies demonstrating how the mind is objectively formed ($O \Rightarrow S$) through the child's active appropriation ($S \Rightarrow O$) of the language and implements of the culture into which it is born. At some point, however, it became evident that the concept of object-determined activity should be enlarged to cover the development of mind in general. This task befell Leontiev, who set out to find the foundations of the psyche in biological evolution. The result of this quest is the general theory of activity, which has had a great impact on contemporary psychological thinking.¹⁴

If the aim of the Cultural-historical School's programme was to make room for the active subject ($S \Rightarrow O$) in the objective psychology ($O \Rightarrow S$) of Sechenov's Russian followers and of the American behaviourists, it did this very literally. In between the O and the S was placed the $S \Rightarrow O$. Leontiev writes: "Thus, in psychology the following alternative was devised: either to keep the basic two-stage formula: action of the object \Rightarrow change in ongoing condition of the subject (or which is essentially the same thing, the formula $S \Rightarrow R$) or to devise a three-stage formula including a middle link ("middle term") - the activity of the subject and, correspondingly, conditions, goals and means of that activity - a link that mediates the ties between them" (Leontiev, 1978, p. 50).

The ensuing sequence could be written 1) $O \Rightarrow S$, 2) $S \Rightarrow O$, 3) $O \Rightarrow S$, where the difference between 1 and 3 is that the latter O is determined through the activity of the subject. Reflection is thus the simultaneous result of objective reality and subjective activity directed towards this reality; the knower and the known has equal importance.

¹⁴ See for example the Proceedings of the 1st International Congress on Activity Theory vol.1-4, Berlin 1986.

The bifurcation

The transformation of irritability (simple stimulus-response) into sensibility and thus the genesis of psyche should, according to Leontiev, be understood as the conversion of $O \Rightarrow S$ into the tripartite sequence early in animal evolution. Leontiev does not exclude an "elementary sensory psyche" in higher invertebrates.

The decisive point of the conversion is the transition from 1 to 2 in the sequence. The animal begins to relate differently to the properties of the object. That, which in irritability was merely a stimulus, has become a signal, one might say.

The peculiarity of sensibility, - "which, although a certain form of irritability, is, however, a qualitative unique form" (Leontiev, 1981, p. 13) - is ascribed by Leontiev to a fundamental bifurcation in the evolution of living matter: "Some of the environment's influences affected the organism as determinants (positive or negative) of its very existence, others only as stimuli and directors of its activity." This split was accompanied by a corresponding differentiation of the functions of the organism. "On the one hand processes that were directly linked with the support and maintenance of life became differentiated... On the other hand processes became differentiated that did not directly have life-supporting functions and simply mediated an organism's links with those properties of the environment on which its existence depended. They constituted a special form of vital activity that also underlay organisms' sensitivity and their psychic reflection of the properties of the external environment" (ibid., p. 45).

This important distinction could be exemplified by the nutritious property of the food-particle and the mechanical property of the same food-particle that induces the worm to engulf it. The first property is life-sustaining, the latter signaling or activity-mediating.

Or, it could be exemplified by the sound of the keeper's steps, which signal the meat-powder, in anticipation of which the dog begins to salivate. Leontiev sets the stage for this interpretation when he writes: "Pavlov assumes the difference between unconditioned and conditioned reflexes, and connects them with the fundamental biological difference between the two forms of connection the organism has with its surroundings - the direct connection and the signalling connection. This differentiation is very significant for the general theory of sensation. Through it the understanding of sensation's signalling, orienting function could be introduced in psychology" (Leontiev, 1977, p. 227-228).

A Pavlovian psyche?

Does Leontiev conceive the origin of psyche as the result of a process similar to the stimulus-response transformation of classical conditioning? It seems so. But Leontiev is ambiguous, and this conception, which turns activity into an intervening variable in what is basically a stimulus-response sequence, is in poor agreement with the essence of his general theory. Leontiev says himself about the $S \Rightarrow R$ scheme, that "no complication of the original scheme ... is capable of abolishing the methodological difficulties which this scheme has presented to psychology" (Leontiev, 1978, p. 49). But his theory, formulated as a three-stage scheme, actually appears as precisely such a complication of the original scheme. Davydov raises the same problem: "In our opinion, the concepts of stimulus and response in the first schema preclude any objective determination and associated activation in the form of exploratory movements... Therefore, the concept of activity should not make the two-term schema more precise, but rather eliminate it" (Davydov, 1981, p. 17).

In my view Leontiev has uncovered a decisive truth in his theory of activity, which he misses in his account of the origin of the psyche.¹⁵ Remember that the first psyche is also the general psyche, and thus the essence of our mind. If psyche can be reduced to the stimulus-substitution of classical conditioning, this is the essence of every psyche from the lowest to the highest.

The theory of activity, of course, contradicts such a deficient view of psychic life, which throws the understanding back to the misguided efforts of the behaviourists. This inconsistency in the thinking of Leontiev, however, is ideally suited for our purpose, as it demonstrates the very problem which must be overcome if the foundation of psyche is to be understood. Namely, the problem of making a real separation of the teleological sensibility from the teleonomic irritability.

You will have noticed, for example, that the tripartite sequence of Leontiev is very akin to our tripartite prototype of reactivity described earlier. The latter could also be written 1) $O \Rightarrow S$, 2) $S \Rightarrow O$, 3) $O \Rightarrow S$. Equally, it is difficult to see that Leontiev's distinction between the life-sustaining influence and the signaling stimulus (mental reflection) is not the same as our distinction between the food-property and the window-tapping property of the organism's object. But this distinction in the relation between subject and object is carried by any form of life, goes with the definition of stimulus-response, and hence with the definition of life itself. Like his great

¹⁵ It should be mentioned that Leontiev - together with Zaporoshets - foistered the Pavlovian idea of psyche in 1936, in which year a Stalinist purge banned the Cultural-historical School and ordered psychology to follow in the footsteps of physiology.

predecessors, Lamarck as well as Aristotle, Leontiev here fails to make a true distinction between the phenomenon of life and the phenomenon of psyche.

The qualification made between the unconditioned and the conditioned stimulus does not turn the trick. Psyche cannot be reduced to the way the window is tapped; it cannot be encompassed within the bounds of the $S \Rightarrow R$ scheme. (If it could, the cyberneticists would carry the day). What we should be looking for is a completely new quality making a vast difference, not just complex variants of stimulus-response. This defines the task before us. We will now search for a different way in which irritability could have been transformed into sensibility in the early evolution of animal life.

The world of simple behaviour

By choosing the Pavlovian model or metaphor, Leontiev emphasises psyche as the objective content of reflection ($O \Rightarrow S$). This classical *cognitive* definition of psyche, has an alternative, as Aristotle wrote. Namely, "the view that the soul is a self-moving entity". We will take this *conative* understanding as our starting point. By emphasising psyche as a subjective act of reflection ($S \Rightarrow O$), we do not fail to appreciate the aspect of objective cognition. But this in itself does not constitute psyche.

Emphasising the acts of the subject, we should begin our quest at the level of simple teleonomic behaviour. We have already described the two principal types of behaviour at this level. The first is our prototype of reactivity, in which contact with a positive stimulus (food) prompts the organism into making a consummatory response. The second - exemplified by Fraenkel and Gunn's woodlice - is that in which a negative stimulus causes the organism to respond with kinesis. The latter is locomotion, the animal (plants have no locomotion) moves from one place to another, which is more optimal. Though kinesis is goal-directed in the sense that the movement indirectly relates to a future situation, it is completely controlled by the stimulus of the immediate situation. As a functional response kinesis is simply negative feedback. The connection between the response and the happy outcome is purely the result of the ingenuity of natural selection. The consummatory response and the kinesis are opposite responses in as much as the first is grabbing for the good things in life, while the latter is trying to escape the bad, but they are identical in the sense that they share the essence of reactivity, teleonomic functionality and irritability. Thus, they are definitely non-psychic.

The situations in which the monad reacts adequately when fortune or misfortune knocks on its window, do not, however, exhaust the possible vital situations that the monad might encounter. There is also the situation when nothing knocks. We should consider not only the positivity and negativity of the stimuli, but also the presence and absence of the stimuli. This gives us the

four different prototypical situations seen in fig. 2, which should be distinguished from each other.

Situations 1 and 2 are already accounted for. The first is kinesis, where the stimulus is present and negative, the second is the consummatory response, where the stimulus is present and positive. Situation 3 hardly needs any consideration. The absence of negative stimuli constitutes no problem for the animal, on the contrary, it is the criterion for the success of kinesis. This leaves us with situation 4.

	Present	Nonpresent
Negative	1	3
Positive	2	4

Fig. 2

A vital problem

Situation 4 constitutes a problem, which might even be critical for the animal. The absence of the positive stimulus and thereby the trigger for the consummatory response simply means a barred access to food, which if continued would eventually lead to the death of the animal.

The solution to this problem would be locomotion, of course, in order to reach out into time and space searching for the stimulus. Kinesis made it possible for the woodlice to move from threatening surroundings into more beneficial, could not the same mechanism direct the simple animal from surroundings devoid of food into more promising ones?

No, it could not. Absence of the positive stimulus is no less a misfortune than the presence of the negative stimulus, but there is a world of difference, which renders the mechanism of kinesis useless in the first case. Kinesis is a response controlled by an external stimulus, if there is no external stimulus, there can be no kinesis. To allow the absence of a stimulus to be a stimulus, perhaps named need¹⁶, would be to confound the whole issue. The problem of situation 4 cannot be solved within the stimulus-response scheme.

Auto-kinesis

Let us approach the problem from the engineering angle of Ashby and Walter Grey and ask, how the kinesis should be reconstructed to handle the absence of the positive stimulus? The answer is simple, the switch should be reversed!

¹⁶ Need as a psychological category is not hereby refuted. Need, however, is not a basic but a higher-order category. The understanding of psyche cannot be based on the concept of need, on the contrary, the concept of need must be based on an understanding of the relations of psyche.

While in Fraenkel and Gunn's kinesis there is straightforward proportionality between stimulation and movement, here there needs to be reversed proportionality. When there is no positive stimulus the 'speeder' should be on and be shut off at contact with the stimulus, whereupon the consummatory response takes over. Whenever in a field without food the animal would be on the move, and according to the same ecological probabilities that brought the woodlice from dry to moist surroundings, the subject would eventually happen upon its life-sustaining object.

This would mean, however, that the animal would be in locomotion whenever it is not provoked to a halt by some external or internal influence. Active movement would then be the normal state of such an animal.

The demands on energy, of course, would be enormous. But this in itself does not disqualify this design. It greatly enhances the chance of getting to the object, and if this advantage exceeds the cost of unceasing movement, it could be favoured by natural selection. Apparently it was.

We could call moving activity unprovoked by any stimulus or outer influence self-movement or *auto-kinesis*, the very word Aristotle uses.¹⁷ The parallel latin word for that which happens of its own accord, without external influence, is *spontane*, and spontaneous activity is a reality of life, as the students of invertebrate behaviour learned, some to their dismay.

Spontaneity of behaviour

The import of the new hard-science physiology reached behavioural zoology at the same time it reached psychology. Jacques Loeb from the University of Würzburg became "the prophet of the new movement", as Fraenkel and Gunn write. "Starting in 1888, he set his face against anthropomorphism and teleology in the study of invertebrate behaviour and began the attempt to describe all behaviour in physical and chemical terms" (Fraenkel & Gunn, 1961, p. 6). It was his general idea that animal locomotion could be explained in the same terms as the movements of plants, i.e. as direct effects of a field of forces. Duly enlarged "the tropism theory might include human conduct also", Loeb (1919, p. 171) writes.

Incidentally, as proof of his "Mechanistic Conception of Life" (the title of his book from 1912) he points to the "artificial heliotropic machine" constructed by Hammond according to Loeb's ideas!

But, alas, life is no machine. Already in 1889 Verworn convincingly established that spontaneous behaviour, irreconcilable with Loeb's scheme, was a fact of invertebrate life. In his famous work *Behaviour of the Lower Organisms* from 1906 the great authority in this field, Herbert Spencer Jennings, con-

¹⁷. Aristotle: *De Anima*, 406b 5-10.

cludes: "A first and essential point for the understanding of behaviour is that activity occurs in organisms without present external stimulation. The normal condition of the Paramecium is an active one, with its cilia in rapid movement; it is only under special conditions that it can be brought partly to rest... The organism *is* activity, and its activities may be spontaneous, so far as the present external stimuli are concerned" (Jennings, 1962, p. 284).

The spontaneity of behaviour is in no way mystical. It does not contradict the pact of the four. "The movements are undoubtedly the expression of energy derived from metabolism", Jennings writes. "The organism continually takes in energy with its food... and continually gives off this energy in activities of various sorts. The point of importance is that this activity often depends more largely on the past external conditions through which the energy was stored up than upon present ones" (ibid.). The behaviour, thus, is not uncaused. It is founded on the laws of biochemistry and metabolism as expressed through the particular structure and history of the animal. In relation to the surrounding environment, however, it is uncaused; no external stimuli prod it along. This is what spontaneity of behaviour means.

Reversal

Being a result of structure and history, autokinesis no less than ordinary kinesis is a teleonomic phenomenon. Just as the kinetic escape from threatening surroundings is biologically meaningful, so too is the kinetic search for promising ones. Both functions share the purpose of securing and sustaining life, but the purposiveness of the designs lies with natural selection and nowhere else.

Their common teleonomic foundation acknowledged, ordinary kinesis and autokinesis nevertheless are very different. The former aims for an undisturbed state. It is thus in harmony with Walter B. Cannon's concept of homeostasis, where the responses through the means of negative feedback serve to restore the tranquil state, the optimum. It could thus be termed *servo-kinesis* in reference to the servo-mechanistic function. The latter, on the other hand, aims for the very opposite: stimulus, disturbance, input, food. It is an appetitive function and reflects the fundamental greedy nature of life, which is better portrayed by the workings of positive feed-back.

However, that which first and foremost interests us is the decisively different way in which the two types of kinesis relate to the surrounding environment, i.e. to the biologically meaningful stimulus relevant in each case.

Servo-kinesis is a model example of the stimulus-response scheme and represents a direct relationship with controlling environmental variables.

Auto-kinesis, on the other hand, per definition defies the stimulus-response sequence, since the response appears spontaneously or prior to the biologically meaningful stimulus. There is no direct relationship between the

behaviour of the subject and the sought for stimulus. No chain of physical-chemical events causally connects the two. The moving animal receives no controlling influence in the form of energy or information from its teleonomic target.

This does not mean, however, that auto-kinesis fails to establish a relation to the food-object. The whole teleonomic meaning of the auto-kinesis is the establishment of precisely such a relationship. Only it is a relationship of a different order.

In order to understand the difference between the environmental relations set up by servo-kinesis and auto-kinesis respectively, we should distinguish three different levels of relation: the vital or biological, the environmental and the behavioural. The first is the vital meaning (negative or positive) of some factor or object to the life-success of the animal. The second is the response-demanding distribution (presence or absence) of this factor in the animal's life-world. The third is the way the animal responds and moves in relation to this factor and its temporal-spatial distribution.

In servo-kinesis the three levels are virtually collapsed into one. The non-directed escape movement is triggered (3) by the immediate contact (2) with an environmental factor which is very detrimental to the animal's health (1), e.g. dryness in the case of woodlice. It is one inseparable event carried by the stimulus-response sequence.

In auto-kinesis, on the other hand, the levels are truly separated. The relation between subject and object, the organism and its food, is vital (1) to the degree that it determines and defines life. Environmentally, however, the subject and object are disconnected due to the absence of food in the animal's immediate surroundings (2). Therefore, the auto-kinetic behaviour is set up (teleonomically) to realise the environmentally unrealised vital relation (3).

The project of servo-kinesis is to disconnect the environmentally connected. Servo-kinesis therefore proceeds from the connection, as happens in the stimulus-response sequence. The project of auto-kinesis is to connect the environmentally disconnected. Here there is no connection to proceed from, therefore the teleonomic necessity of spontaneous locomotion, or the reversal of the stimulus-response sequence. In servo-kinesis the relationship to the vital factor in the external environment is reactive. In auto-kinesis it has to be active.

The alternative

As ascertained by Jennings, auto-kinesis based on spontaneity is no less a fact of life than servo-kinesis based on stimulus-response. Here, then, we have the alternative to the $S \Rightarrow R$ model, which Davydov found irreconcilable with the theory of activity. The concept of activity developed by Leontiev is much

more compatible with the subjective self-activity of auto-kinesis. Actually, what he pursues in his works on activity from infusoria to man is essentially this.

The auto-kinesis is simply the first form of activity, understood as a behaviour relating, not just responding, to the external world. Hence auto-kinesis offers an alternative opening to the understanding of psyche, which does not get bogged down by the trappings of stimulus-response and conditioning.

What kept Leontiev from this conclusion which is so much demanded by his own works? A very good reason, I presume. The essential aspect of psyche in Leontiev's understanding is the cognitive. The reflection of the objective world ($O \Rightarrow S$). Auto-kinesis, devoid of any stimulus input, offers no such thing. It seems to be pure subjective conation ($S \Rightarrow$); the latter term denoting nothing more than the spontaneous movement of the organism as described above, and thus fully agreeing with the pact of four.

This brings us back to the discussion between Henrik Poulsen and myself. Neither Leontiev nor Henrik Poulsen were wrong in emphasising the cognitive aspect as the *sine qua non* of psyche. But is auto-kinesis really devoid of this decisive aspect? With this question we are approaching the crux of the whole matter.

The riddle of the absent present

The contradiction mentioned by Davydov and Zinchenko appears in auto-kinesis as well. The effort to connect the disconnected presupposes in itself the connection. It simply implies that the unrealised link between subject and object, that the auto-kinesis tries to realise, is already a reality. The absent must already be present!

This riddle is easily solved, however, when we make use of our distinctions. Biologically the subject and the object, the organism and its food, are inseparably connected. Not only does this relation define life, it also determines life. The object is the other-being of the subject. As long as the organism is living, and thus a subject, its biological relation to the food is always a very present reality.

Environmentally, however, the subject can be, and often is, separated from its food. This absence of the food-object (and hereby the absence of the positive stimulus for the consummatory response) also confronts the organism as a reality.

The behaviour of auto-kinesis as designed by natural selection serves to bridge the two realities, so the environmental reality does not refute the biological. Auto-kinesis is at the same time a behavioural expression of the connection and of the disconnection between subject and object.

Being a reflection of the absent object, and thus of the object, auto-kinesis is definitely cognitive behaviour. Cognition refers to objective relations of the external world as they are reflected by the subject, and the external world's objective relations are certainly being reflected in auto-kinesis, since the presence or absence of the object is an even more basic objective relation than the magnitude, distance and direction of the object. The most basic of all, actually.

The particular reflection of the object in auto-kinesis is, however, prior to the stimulus, and is thus more in accordance with the understanding of the rationalists than with the understanding of the empiricists. This reminds us of the famous exchange between Locke and Leibniz, the latter answering the Englishman's claim, "that there is nothing in the mind, which was not first in the senses", with the retort: "Nothing except the mind itself!" The mind is not a board upon which the world writes ($O \Rightarrow S$), it is subjective, cognising activity ($S \Rightarrow O$). Exactly the point later made by Brentano.

Psyche

Without any infraction of the physiologists' pact, auto-kinesis could be called exactly subjective, cognising activity. Does that mean that we attribute the quality of psyche to auto-kinesis?

Yes, it does. The immanent objectivity or intentional inexistence, which we in accordance with Brentano have defined as the hall-mark of the psychic, is exactly the relation auto-kinesis establishes to its object. The locomotion is a biological expression of the object, which is not present, but searched for. It thus belongs to "such phenomena as include an object intentionally within themselves", which is Brentano's definition of psychic phenomena.

The immanent objectivity or intentional inexistence of the object is beautifully expressed by the reversal of the stimulus-response sequence in auto-kinesis. The reversed sequence would be response-stimulus. This is apparently a *contradictio in adjecto*, since the effect appears prior to the cause. But it is not biologically meaningless. Teleonomically spontaneous locomotion is a response to the object, which is nonpresent. Hence the immanent objectivity of auto-kinesis. In this way the object is the cause of the locomotion, only it is a cause that lies in the future not in the past. Such a cause is a goal. By the same reversal the future stimulus directing the response is a motive. The object is materially non-present, but in the movement of the animal it is present as intention and goal. Auto-kinesis represents the first case of "the fundamental, cardinal aspect of the vital activity of every sentient being - a subject". In the words of Davydov and Zinchenko: "To look for something that does not yet exist but that is possible and is presented to the subject only as a goal, something that exists as an idea and is not yet actual".

The term idea expresses the same as Brentano's immanent objectivity. From the double existence of the object as being in the world and as being in the reflection of the subject rises the concepts of the material being and the ideal being. Both beings are real. Auto-kinesis is an ideal expression of the material object. This ideal expression is also the cognitive aspect of psyche. Likewise it is the intentional aspect. In auto-kinesis the conative act and the cognitive content are indivisible. This oneness of act and content, however, is another important characteristic of psyche. Objective reflection is not the unshared property of the psyche. It is a property of all matter.¹⁸ It is the *subjective reflecting* of the objective that sets psyche apart. This is what Leontiev has in mind when he defines psyche as the living organisms' "ability to reflect in *subjective experiencing* the reality around them (italics added)".

The final mark of psyche is not wanting either. If auto-kinesis is a reversal of the causal relationship of the stimulus-response sequence, whereafter the animal moves with reference to a future goal rather than according to past or present influence, then it, of course, represents a true teleological relationship. The animal is not stirred into action by some stimulus, prior to any stimulus it is actively reaching out in time and space for its object.

The reversal represents the real difference between irritability and sensibility. In relation to the external world the organism in the first case ($S \Rightarrow R$) is little more than the object of the stimulus hitting it. In the last case ($R \Rightarrow S$) the animal is a true subject, de facto moving out to meet the stimulus. Put in terms of subject and object, the ($O \Rightarrow S$) of the first case is in the last case preceded by the ($S \Rightarrow O$). On one side we have just ($O \Rightarrow S$), on the other we have ($S \Rightarrow O \Rightarrow S$), which of course recalls the exchange between Locke and Leibniz, the latter denying that mind is a sitting duck.

The difference is very great between a stimulus 'received' and a stimulus 'perceived', that is read into the activity or performance of the subject. It is the experimental well known difference between simple afference and refference. Actually, Leontiev was confronted with precisely this difference in his experiments on the genesis of feelings, which forced him to conclude that "a necessary condition for the rise of the studied sensations is a presence of a certain directed activity of the subject" (Leontiev, 1981, p. 68). "This meant *that the process resulting in the emergence of sensitivity to an ordinary unsensed agent and the forming of a conditioned-reflex association were not identical processes*" (ibid., p. 108). We would have added the italics, had Leontiev not done so himself.

¹⁸ See Jens Mammen's paper in this volume for a dialectical-materialistic analysis of the general reflecting essence of all matter, that is the extraction or abstraction of objective properties through relations.

The (S => O => S) chain defining the psychic could also be written in this way (S =>O)(O =>S). It has exactly the same structure as the schemata defining life (fig. 1). Psyche thus is a generalisation or extension of the principle of life. The biological principle is extended to a behavioural-environmental principle. From the biological subjectness of the monad develops the psychological subjectness of the active organism relating to the world. Irritability is transformed into sensibility.

Two realities linked

Auto-kinesis represents a real somersault in the development of life, but this does not mean that auto-kinesis is not still just auto-kinesis. The concepts of subjective activity, cognising act, immanent objectivity, intentional inexistence, motive, goal and idea, notwithstanding, auto-kinesis is perfectly - and only - explainable in the earlier mentioned physical-chemical and biological concepts of negative entropy, metabolism, function and teleonomy. Very likely spontaneous locomotion is the freak result of the accidental incorporation of microtubuli into some primordial cells; microtubuli being complex molecular structures with the odd physical-chemical property of perpetual movement, thus furnishing the monads with an organ and source of spontaneous locomotion. This fortuitous development would be in complete harmony with the pact of the four, entirely within the understanding of modern physics, biochemistry and biology. Nothing but chance, natural law and natural selection would be called for to explain it, the evident purposiveness of the thing being only a case of teleonomic functionality.

What it does mean, however, is that with the arrival of the purely biophysical phenomenon of auto-kinesis an entirely new relation is brought into existence. Namely, the teleological relation between the subject and the object, meaning that the subject *de facto* acts with reference to a future goal. This subjective relating is *psyche* and its qualities are intention, goal, idea, motive, etc, which qualities are brought into existence by the sheer fact of autokinetic locomotion. Psyche, thus, is not a substance or a force. It is an expression of a unique material relationship in the world, as are all the basic steps on the cosmogenetic ladder, the nuclear, the atomic, the chemical, the living.

Each step on the ladder is connected to the prior, and yet altogether its own, as is always the case with development. On the foundations of physics, chemistry and biology thus is born an entirely new reality with its own unique principles or logic, therefore requiring its own science and its own concepts. The new science is psychology.

Auto-kinesis thus links two separate scientific realities, like the electron shell of the atom links the separate scientific realities of atomic physics and

chemistry. Such material linkage is always the case between neighbouring sciences on the evolutionary scale. This is what we meant, when we said that the origin of the psyche is beyond psychology. The science of psychology must begin with the psyche as a positive fact.

Definition

The short, positive definition of psyche is teleological activity. It is from this fact that thinkers have proceeded throughout history. It is nevertheless very important to include in the definition the complex material evolution that brought the psyche into existence and thus the complex interconnections between the sciences. Summing up the above would be an attempt at such a definition.

1. Given life, that is the biological relation between subject and object, and thus, given the vital necessity of the object as other-being for the subject (all founded on bio-physical relations as developed during early chemical evolution);
2. Given an environmental field in which there are no objects of food in the immediate surroundings of the animal, but where objects of food are obtainable at some distance;
3. Given the spontaneous locomotion of the animal (which itself is founded on bio-physical relations as developed during the natural selection of early organisms);
4. Given these, the locomotion will by the laws of probability eventually result in contact between the subject and its object, even though no stimulus is guiding the locomotion.
5. This means that the locomotive behaviour establishes a *real* connection to *the absent object*, despite the fact that there is no immediate material contact in the form of energy or information between the subject and the object.
6. The reality of this non-material connection as expressed through the activity of the subject we term *psyche*. As a reflection of the non-present object we term the processes associated with the movement the *ideal* expression of the object. It is synonymous with the term *immanent objectivity*. The concepts of ideality and immanent objectivity are necessary to express the fact that there is a real relation (real in terms of life and death) between subject and object, which is not carried by any material input from the outside. As the vital necessity of reaching the object is the biological basis of the spontaneous locomotion, we express this by talking about the *intentional inexistence of the object* in the activity of the subject. This is synonymous with the term *goal*. Being goal-intended activity we also use the term *teleological* for the active relation between the subject and the object.
7. The teleological activity belongs to the class of teleonomic relations, its purposiveness being a result of natural selection. It differs from non-

teleological relations, however, in the way the purposiveness is mediated. In non-teleological reactivity the purposiveness is mediated through causal chains of external influence. Lacking this material basis the organism must itself (through spontaneous locomotion) mediate the life-sustaining relation to its object. This is what teleological means.

This definition, by the way, also tells us when the relation of psyche first came into existence. It came into existence with the first case of spontaneous locomotion, which effectively changed the probability of reaching non-present food. No doubt, this was early in evolution. Personally I fancy the protozoans as the first organisms partaking in this new reality, rapidly moving their cilia or whipping their tails, but most likely it was already some bacteria, hard as it may be to connect bacteria with anything psychic. The simplicity of the organism, however, has nothing to do with it. Psyche is not an inner property of the organism requiring some special structure or equipment. It is a particular relation in the world brought about solely as the consequence of spontaneous locomotion as spelled out in the definition. This is why sessile forms of life, like plants, do not have psyche.

The reality of psyche

Does this make our definition of psyche an operational definition? Yes, it certainly has much in common with H.S. Jennings' famous anchoring of psychic terms to objective criteria of behaviour in chapter 20 of *Behaviour of the Lower Organisms*. When the animal moves in this particular manner in relation to its object, this is psyche, we say, implying nothing else than the observable features of the behaviour and the way it relates to the environment.

This does not mean, however, that it is a descriptive or nominal definition referring only to the use people make of words. The behaviourists-to-be understood Jennings in this way, when he compared the reactions of amoeba with the psychic manifestations of man and wrote: "Thus it seems possible to trace back to the lowest organisms some of the phenomena which we know, from objective evidence, to exist in the behaviour of man and the higher animals, and which have received special names" (Jennings, 1962, p. 355). To Watson and his comrades-in-arms psychic references were only special names, and so a whole new branch of science was founded on the misconception that psyche is a product of language and an epiphenomenon.

Our operational definition is a *real* definition referring to objective properties of the world. When we define psyche as a certain set of biological, environmental and behavioural relations, this does not make psyche an epiphenomenon. Psyche is no more an epiphenomenon than elephants or traffic jams. Psyche is a real relation coming into existence in the real world. Jennings knew this too. Sharing "the ideal of most scientific men", namely "to

explain behaviour in terms of matter and energy, so that the introduction of psychic implications is considered superfluous" (ibid., p. 329), he nevertheless had to admit the real subjectivity of the organism: "In conducting objective investigations we train ourselves to suppress this impression, but thorough investigation tends to restore it stronger than at first" (ibid., p. 336).

The final touchstone of biological reality is natural selection, and natural selection has not failed to prove the reality of psyche. Being a real relation determining the life success of the animal, psyche was soon worked upon by the forces of evolution. Any variation improving the teleological short-cut of teleonomical purposiveness was favoured. From the blind auto-kinesis of the monad evolved forms of cognising locomotion that could reach further and further out in time and space. New organs of locomotion evolved hand in hand with new organs of sensation. Brains evolved to accommodate the computation of the yet unseen. At some point, what we call mind evolved, the ability to monitor not only the world but the relation to the world as well. Finally, the consciousness of the human being evolved.

These steps in the ladder of psychogenesis should not be confused, each has added a new quality to the reality of psyche. All the evolutionary forms of psyche share, however, the fundamental essence of psyche.

"Action is as spontaneous in the protozoa as in man", Jennings writes (ibid., p. 261), and from this spontaneity or freedom of external control rises the teleological relation of psyche, when the *free* subject moves to realise the *necessity* of the object. From monad to man psyche is self-movement and cognition united in the self-willed goal-intending act. Or put in the words of Wilhelm Wundt from *Grundzüge der physiologischen Psychologie*: "What confronts us as the typical forms of psycho-physical events from the simplest spontaneous movements of the protozoans to man's highest manifestations of life, is voluntary activity" (Wundt, 1903, p. 744).

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