

the philosophy of morphogenesis

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*The following is a translation of the final chapter of Raymond Ruyer's 1958 *La genèse des formes vivantes*, forthcoming from Rowman Littlefield International.*

*Ruyer's goal in *La genèse* is, first of all, to critically assess what were the contemporary scientific accounts of embryogenesis. He finds these accounts deeply problematic, fundamentally as a result of a continuing fidelity to classical Newtonian physics, which construes living beings as mechanisms: that is, as discrete, inanimate parts arrayed in a neutral space and connected *partes extra partes* according to a given structure. Not only is this view of reality, for Ruyer, clearly debunked by quantum physics, it is manifestly incapable of dealing with the dynamic, continuous and transforming process of embryogenesis. The latter can in fact only be understood by invoking a formation that is irreducible to the playing out of a pre-existent structure; the playing out of a trans-spatial ideal irreducible to an aggregate of brute cause and effect relations.*

Ruyer's thorough grasp of the sciences of his day is on clear display in this chapter, traversing not just embryology but biology more generally, neuroscience, psychology, animal ethology, and physics, before arriving, finally, to challenge the oldest paradigm of fixity in Western thought: Parmenidean being. As he indicates in the opening passage, Ruyer's aim in this concluding chapter is to summarise his critique. But it also provides him with an opportunity to present his own positive account of morphogenesis, not just with respect to the embryo, but to reality as such. For this reason, what follows can be

read as one of the more thorough-going summaries of his mature philosophy.

Terms marked with an asterisk appear in English in the original. Ruyer occasionally uses a smaller type face to present a discussion of a specific topic or example; he does this here on p.18 when considering the nature of standardised IQ testing.

—Jon Roffe and Nicholas B. de Weydenthal

Having compared the effort of tracking and cornering the mystery of morphogenesis to a criminal investigation, we can also present its conclusion in the same mode.

What appears clearly right away is the insufficiency of the notion of functioning borrowed from mechanist physics. A host of logical and experimental arguments can be deployed to prove the point that morphogenesis is irreducible to functioning, that is, to the setting in motion of a predetermined structure given in space.

THE IMPOSSIBILITY OF SPATIAL PRE-FORMS

This is, logically speaking, to misrecognize the position of the problem, to reduce formation—that is to say the *appearance* of a structure—to the *deployment* [*mise en marche*] of an already existing structure. Functioning can only lead to the deterioration of that which functions.

Experimentally, the theory of preformation, which is the biological form of the theory of functioning, has been completely disproven. Even if, at the beginning of development, we look everywhere for hidden pre-forms—whose functioning would explain adult forms—we find nothing. Pre-forms are in neither chromosomes nor in genes. In fact, genes are distributed equally among all the divided cells in development. Let us grant, for the sake of argument, that genes could account for what Woodger² calls “characterisation” (that is, specific characteristics), for the fact that a paw, tail, or liver of a dog is not the paw, tail or liver of a cat. What it cannot account for, however, is “organisation,” the fact that these particular embryonic cells will become a liver, or a tail, rather than a paw. This is particularly clear for the two, four, or eight cells that first result from the initial division of the egg. The nucleus has certainly been divided equally, since each of

the two, four or eight cells will give rise to a complete individual. It is not therefore the nucleus and its genes that explain the organisational differences between the right and the left half of the organism, or the front and the back, or the head and the tail. Incidentally, experiments with grafting show that the destination of a group of cells can be changed practically at will. What would have become a paw becomes a tail, and vice versa. Genetics cannot therefore explain embryogenesis.

Let us consider, again for the sake of argument, that the organisational pre-forms are found in the protoplasm. In many eggs, the protoplasm presents regional differences visible from the very beginning. The primer for bilateral symmetry, of the front and the back, the head and the tail can be recognized. However, the objections against the pre-forms in the nucleus also hold for the pre-forms in the protoplasm. Grafting experiments modify not just cellular nuclei, but the protoplasm as well, and yet the development is normal or normalised. In general, the visible differences in the protoplasm appear to be due only to the presence of nutritional reserves. Their development is not always modified by their displacement through centrifugation. Should we then invoke invisible chemical differences? In the egg, whose development is “mosaic,” a chemical heterogeneity between the egg’s parts can be found early on. In regulatory developments, though, a certain chemical homogeneity is conserved until gastrulation.³ Now, regulatory development is, as we have seen, the fundamental case; mosaic development would simply signify a premature determination.⁴ If chemical heterogeneity is already the sign of a determination, that is to say, of the establishment of a formative process, how then could it be its cause?

Extraordinary difficulties are encountered if pre-forms of “organisation” are located in the protoplasm, or pre-forms of “characterisation” in the nucleus and the genes. In effect, during the course of evolution, the most general and fundamental organisational traits—which are today, according to neo-Darwinism, characters of kind or level—are due to first appear as mutations in a species. At this moment, according to the hypothesis, they have to depend on factors or pre-forms in the chromosomes. However, still according to the hypothesis, as characters of kind or level, they must depend on pre-forms in the protoplasm. Now, how can we possibly conceive of the transfer of these pre-forms from the nucleus to the protoplasm? Placental organisation, mammary glands, the mammalian instincts of nutritional lactation had to have appeared as genetic mutations. How could these genetic mutations themselves become the fundamental traits of their own organisation and embryogenesis?

THE INSUFFICIENCY OF RELATIONAL EPIGENESIST

Given that there are no pre-forms in space, there remains only to admit, for the sake of argument, a sort of epigenesis through spatial relations themselves. The increase in structural complexity, during formation, is explained by the external or internal relations of the egg in development—relations with its milieu at first, and then, after the first divisions, inter-cellular relations. This is the solution at which Woodger arrives.⁵ A pure multiplication is not, by itself, a gain in complexity. However, a unified plurality of objects represents a level of organisation superior to that of each individual object that composes it. A forest can spring from a single tree, and yet the forest represents a superior level of organisation, in the sense that, for example, the trees on the edge will have leafy branches reaching ground level while the trees in the centre will have leaves only at the canopy level. One fully-grown flower would thus be a sort of “forest” of simple flowers, differentiated according to their place in the whole.

This “relational” or “social” explanation of morphogenesis, which is advanced today by Dupreel but also derivable from Gestaltist conceptions, has only a limited applicability.⁶ We have shown that the situation, or the primary role of organic components in the whole, only acts as an evocative stimulus of capacity, and not as its sufficient cause. This is already the case for the leaves of a tree in the forest, and, even more so, in the differentiation of fully-grown flowers—and even more so for the differentiation of cells in an animal. If the relational conception is true, the graft, in transplant experiments, should always act “locally” and never “originarily.” The determination of a tissue often depends in an indirect fashion on its location and its relations with another tissue. If, for example, a gastrulation towards the exterior is provoked, neutral differentiation does not take place due to a lack of good spatial relations, and the whole development is arrested. However, it would not be wise to take this as a ruling in favour of the “relational” theory, which would be like explaining the painting of a scene by relating painter and canvas in space. The relational theory does not explain the organism’s type, whose specific forms are maintained *in spite of* the milieu, and often in spite of incidental upheavals in their internal relations.

“Social” phenomena are real and of real importance in the whole domain of biology, but organic “sociality” is irreducible to a simple spatial “vicinity” produced by mechanically relational effects. Such a conception is only a return, in disguised form, to a theory of developmental functioning.

The efforts of biologists who cling to the idea of functioning are even more unjustifiable in light of its decades-old abandonment by physicists and chemists. What we have called the crisis of determinism is in fact the crisis—or rather, the abandonment without return—of the conception of physico-chemical phenomena as structures *first given in space, then put into motion*, and functioning according to *ready-made* connections. An atom is already in itself a process, a formative activity; it is not a functioning structure. The morphogenesis of an animal, as complicated as it is, nonetheless follows atomic and molecular “morphogenesis,” as the existence of the living molecules that are the virus show. And the morphogenesis of an animal reveals the same traits writ large that are found in the “morphogenesis” of an atom, already in excess of functioning. There is today a true game of hide and seek between physicists and biologists. Biologists continue to make use of an outdated chemistry; physicists, who, in general, have the most misconceptions about genetics, ignore the fact that embryogenesis is an active *formation*.

FORMATION AND CONSCIOUSNESS

Let us resume the investigation. Having recognised the insufficiency of functioning, one has to then search for the positive factor of morphogenesis. This factor appears, *as a first approximation*, as complimentary to functioning, and takes on various aspects. They can be described them as “vertical themes,” “auto-conduction and auto-control,” “unitary behaviour,” “action according to an absolute surface,” “equipotentiality,” “mnemic melody,” “ability to react to a simple signal,” etc. Under all of these aspects, the causal factor essentially represents an improvisation and a *creation* of bonds [*liaisons*], in contrast to the simple *play* of pre-given bonds which characterises functioning. Finally, under all of these aspects the morphogenetic factor is revealed to be very close, not to a mysterious “vital principle,” but to the immediate experience of consciousness. All these aspects (themes, auto-conduction, etc.) are at the same time aspects of consciousness. Consciousness is not a passive knowledge, but the active unity of a behaviour or a perception. Consciousness *is* always a forming activity. It is always a dynamic effort of unification, without which “behaviour” would be a pure collection of movements and perceptions a pure juxtaposition of physico-chemical effects able to be imitated by machines. It is therefore natural to suppose that morphogenesis is, to the contrary, always consciousness. This hypothesis, we must underline, does not consist in saying that consciousness *explains* morphogenesis; it rather asserts that consciousness and morphogenesis are one and the same.

It is nevertheless important to understand that psychological consciousness (whether human or animal) that perceives objects in the world and acts on the world is a morphogenesis in one particular organic domain, that of the nervous system—those veritable amoebic colonies that constitute the systems where liaisons are incessantly made and unmade according to themes derived from the broader theme of the organic but adapted to the outside world. This neural morphogenesis is then transposed, through the relays of organic machines, into movements in space. Naturally, though, this cerebral consciousness or morphogenesis is only a particular case, derived from organic consciousness and morphogenesis. An embryo in formation is a field of consciousness as much as it is an active cerebral sensori-motor area. It also improvises the new connections according to a theme; it is absolute surface and melody, like the cinema screen in *The Mystery of Picasso* on which each state of the painting serves as sign for another state.⁷

Or better: it is because the embryo is the domain of primary consciousness that this embryonic part, consisting of nervous systems, can be the domain of perceptive consciousness, and can facilitate organic behaviour by adjusting it to the extra-organic world. We walk and we see, and we manipulate objects because our cerebral nervous tissue is directly capable of modifying itself and of possessing itself absolutely in its thematic forms and deformations. *Our hands of flesh and bone are only the auxiliary machines of the “absolute hand” of our cerebral cortex.* While the corporeal hand was being formed, drawing from the embryonic palette which gave it its outline it was already “absolute hand”—surface in possession of itself and sounding melody—independent of the cerebral hand that did not yet exist. However, in the adult organism—to the degree that it is alive, that is, capable of partially repairing and maintaining itself through nutrition and assimilation—it is no longer the “absolute hand.” As tool-organ, it can only function like a set of tongs or pliers, and all control of its behaviour has been transferred to the cerebral hand. It is the cerebral hand that is the “control” and consciousness of the active handling that facilitates the physical movements of the hand-organ.

We should not, however, be misled by this secondary dissociation. To the degree that it has not already begun to function in accordance with deployed machines, the embryo in development is a complete field of consciousness. A nervous centre, an embryo or an embryonic area in formation, an amoeba or a unitary colony of amoebae such as *Dictyostelium*, or even, let’s add, a molecule in which the zones of individual indetermination have been reunited in a continuous network—all of these domains are equally domains of consciousness, just as they are domains of

morphogenesis.

Consciousness in morphogenesis is not a superimposed principle, a *Deus ex machina*, or a ‘ghost in the machine.’ It is nothing other than form, or, rather, active formation in its absolute existence.

Contrary to those theories inspired by (often poorly understood) Husserlian ideas, consciousness is neither always nor essentially “consciousness of...,” consciousness of a real or ideal object. The consciousness inherent in formation is not consciousness *of* a formation, either as light or as intention directed toward this formation. Primary consciousness is not “consciousness *of*...” Only the consciousness of cerebral sensorial centres *qua* cerebral area becomes “consciousness *of*...” Having been modulated by an exterior structure, consciousness envelops the existence of this structure or refers to an object through it, and can as a result legitimately be called “consciousness *of* the object.” The primary consciousness of formation, if this incorrect expression, involving a genitive that does not *refer*, absolutely must be used, is this formation *qua* formation that conforms to a general theme that dominates the constitutive elements. Consciousness *of* an habitual action is not the consciousness of performed movements (which would, on the contrary, disturb action); it is the active unification of constitutive elementary movements *according* to the theme of the action. Where primary organic consciousness is concerned, it is as illegitimate to employ the “of” in Berkeley’s sense as it is in Husserl’s. Primary consciousness is neither consciousness *of* a perceiving Mind-subject nor the consciousness *of* an Object, whether real or ideal. Consciousness *is* any active formation in its absolute activity, and all formation *is* consciousness.

The viewer of the film, *The Mystery of Picasso*, has the illusion that the painting is painting itself since he does not see the painter behind the canvas. However, if we consider the painter’s consciousness, the viewer’s illusion corresponds to reality itself: the painting must form itself without a brush held by a hand being at work behind consciousness.

THE PHILOSOPHY OF ‘VERTICALISM’

The investigation into morphogenesis cannot end here. Having identified formation and consciousness, and jointly characterised them as auto-conduction and the improvisation of bonds according to a theme, it is necessary to pass from description to an attempt at interpretation and to finally find, certainly not the

cause of consciousness and formation—which would obviously make no sense—but rather their fundamental implication. At the beginning of this book, we invoked the metaphor of “verticalism” to describe the general impression that first arises, given the facts of development. We saw very quickly that the metaphor has more than merely a descriptive value. Biological induction, the evocation through simple signals of formational competences, truly epigenetic appearance in space and time, and specific complex structures all lead us to admit a non-geometric “dimension” - a “non-spatial” region in which the “ideals” of specific forms subsist in a “semantic” state, a state of significant themes analogous to the themes of an habitual act or an effort of memory or invention. At the same time, these ideals act dynamically on that which actualises them, and are actively realised by it; in turn, these are adopted as *its* ideas. This particular composite of activity and passivity is characteristic of all consciousness. The cycles of mechanical auto-regulation merely “symbolise” (in the Leibnizian sense) this characteristic, and only represent it in a “degenerated” state.

In any case, this conception suggests itself whenever we try to understand psychological consciousness. The studies of the Wurtzburg school, psychoanalysis, the psychology of instinct, and above all—since the revolutionary conceptions of H. Jackson—the studies of aphasia, have proven the reality of a semantic “verticalism,” and the central place of the trait [*tâche*], the theme, or the dominant tendency in behavioural and intellectual formation, which are incomprehensible if we remain at the level of pure “horizontal” associations. The brain serves as the “control”—in the cybernetic sense of the word⁸—for the movements of the organism. It is that which informs these movements, and makes of them true behaviours, unified and guided. But while the “control” of an automated machine is also a machine whose construction must be controlled by an engineer, the cerebral control operates directly, because the brain, visible in space, is only the place where the non-mechanical *feed back** to non-spatial ideals and themes is applied.

Let us observe the manner in which our actions on the outside world are regulated. The dynamic nature of our actions turns around the positing of a value-goal, and around diverse valencies, “fixed” on intermediary-objects, inhibitive or supportive that are displaced as action progresses. These “valorisations,” inherent in conscious activity, correspond to the improvised modification of liaisons in the cerebral centres. Consciousness, or the formation of the current act, thus corresponds to the intersection of ideal themes and the organic machine in space. This “dimension” of thematism is that which takes place in the adult and auto-con-

ducting organism, the engineer controlling the “control” of machines. According to J.C. Eccles⁹, the “will”—it would be better to say: the “vertical” themes—transforms the spatio-temporal activity of nervous systems into a state of unstable closure by exercising already structured “fields of influence”¹⁰. *Alpha* waves in no way represent, as it is sometimes suggested, a cerebral *scanning**. It is rather that they cease as soon as a visual activity or mental calculation begins—which is in itself a return to a pure and autonomous functioning of rest of the nervous system, and which escapes the control of “vertical” themes.¹¹

However, since psychological consciousness is only one particular case of organic consciousness, and the cerebral formations one particular case of organic formations, all recent discoveries in neuro-psychology must be valid, *mutatis mutandis*, for morphogenesis in general. All organic tissue in development is the site of the intersection between formative and regulative themes, and structures in space. All organic formation, like all cerebral activity, is controlled and regulated by non-mechanical *feed back** in accordance with a trans-spatial ‘ideal’. An *in vitro* cell culture, into which a specific factor of differentiation is not introduced, resembles a cerebral area at rest emitting *alpha* waves. However, in the developing embryo all determined areas are put into circulation according to a theme that guides its differentiation, by modifying its internal liaisons and displacing its valencies.

For the purposes of this account, we have spoken as if, by beginning with functioning and its recognized insufficiency, we had to look for a supplement which would transform functioning into a morphogenetic behaviour. In reality, of course, it is morphogenetic behaviour that is primary, and functioning that is derivative in all true beings, as opposed to pure aggregates. Action, for modern physics, already indissolubly unifies time, space and energy; the cutting-out of an action in the time, space and energy of a particular system is always artificial and relative. The behaviour of an atom cannot be decomposed into a discrete functioning—itsself already decomposed according to an absolute space-time—or into an *x* factor that modifies the functioning. The atom does not resemble the machines engaged by human activity *plus* something—on the contrary, phenomena and their laws make possible the existence of these very machines. Even less does the organism resemble a material machine, delivered passively into time and modified at each instant by an idea, an entelechy, beamed down from heaven. To recognise the dimension of a trans-spatial thematism indissolubly combined with spatio-temporal dimensions is not to accept the old dualism between body and soul, “entelechy” and matter, idea and reality, or vital principle and organic machine. The

organism is not a machine *plus* a soul. Organic beings only subsist dynamically - in an incessant flux that, every few months, renews all its molecules. It is constant activity and the permanence of dynamism, not the permanence of a material reality informed retrospectively by an ideal form.

Having identified formation and consciousness, we must guard against the conception of consciousness as the attribute of a mind-substance, and against conceiving of thematism as the passive reflection of a static Platonic idea. Consciousness is neither a distinct ingredient, a sort of added phosphorescent substance, nor the attribute of a spiritual substance. Consciousness is nothing but the act, whether intelligent or instinctive, perennially engaged in the thematic organisation of sub-domains, themselves in the process of organisation. Cerebral consciousness, the active improvisation of formations in the nervous system, is at the root of the activity of organic consciousness that, for example, is ceaseless in its pursuit of the oxygenation of cerebral cells, or that actively maintains proteins in their form. The horse is not material organic tissue *plus* the Idea of Horse¹². The horse is a horse because it “horses.” It is not that, before passing through the “blastula” stage, it is a pre-blastocoelic embryo *plus* the Idea of gastrulation;¹³ it has actively gastrulated, as actively as a bird migrates or nests. To conform to an idea, a mnemonic or instinctive theme, is still to be active.

FORMATIVE ACTIVITY AND MEMORY

Following Whitehead, R.S. Lillie¹⁴ has emphasised the fact that while the activity that produces novelty appears to be the prerogative of consciousness, the constancy of things, the stable and conservative side of nature, appears to be physical.¹⁵ Conscious existence is in the present and carries with it novelty and novel integrations. The past is what is left behind it as it advances into the future. The psychological, as Whitehead says, is always part of the creative advance of novelty. This conscious creation of novelty through integration always operates on a system that is pre-given and pre-structured by antecedent and subjacent activities, and it leaves in turn its structural imprint, its information—in the etymological sense of the word—on the system, which in this way develops according to an advancement of consciousness, while continuing to operate according to already acquired structures. This is to invert rather than to support the mechanical determinist view which asserts that the present actualisation—always action and always consciousness—is exclusively determined by the past. In fact, it is the past itself, or more precisely, previously acquired structures, that represents the

traces left behind in the integrated sub-systems by the creative advancement of actualisation. Biological “determination,” far from being the result of a determinism—that is to say, the functioning of what already exists—is always prospective. It resembles the carrying out of a new construction plan; it inaugurates a new instalment of formation; it is the announcement that a new theme will be put into play. The time of pure functioning, in which the present proceeds from the past, is nothing but the conventionalised and deformed product of the time of conscious actualisation, inapplicable to organisms in formation. In a “moment” [*tranche*] of conscious actualisation, there is no pure flowing of time from the past to the present, but rather the circulation of an atemporal theme in a domain, inaugurating an action that brings about a new spatio-temporal domain. This new domain appears to be continuous with the one that preceded it, but it does not flow from it like the sand in an hourglass.

It is necessary, nonetheless, to specify the nature of “traces” and structurations left by creative advancement. These traces are, at a first approximation, of two very different types. Contrary to what R.S. Lillie⁶ seems to believe, they are not solely physical and material—that is to say, they are not analogous to the traces left behind by an orator’s voice on a vinyl record. They are also “psychic,” which is to say the actualisation of a theme or an idea produces recurrent effects on the non-spatial theme, and modifies it according to an ascending action that passes from the actual to the trans-spatial. The orator who improvises a speech by actualising an idea produces physical effects that descend into the outside world; he produces a series of waves that can be recorded and conserved, due simply to the inertia of the vinyl or a magnetic metal. We can also suppose that the orator, after having spoken, takes notes so as to be able to eventually recite the improvised speech. Finally, we can suppose that the orator’s nervous system, in its material structure, endures modifications analogous to those of the vinyl. But do conscious and creative advances have any effects other than material modifications? Such a thesis is unsustainable. Let us suppose that the orator would like to later repeat the speech that he had improvised. He consults his notes, which are, materially, only traces of ink on paper. They are nothing unless a conscious human being can understand and interpret them as signs. If in the meantime he suffers from agnosia, he will be incapable of using them. Can we say then that the interpretation of written signs depends on the sole cerebral traces of the orator, considered in themselves as a sort of writing or material recording left in the matter of the brain? But a material inscription, whether on cerebral tissue or paper, *cannot read itself*. Even the orator, having become aphasic, *tries* to speak; he still has the ideas

whose actualisation is betrayed by the accidents that supervene on subordinate processes, psycho-motor schemes belonging to inferior levels that were developed through antecedent activity. He is not betrayed by a purely material confusion of purely material traces. An aphasic is not the same thing as a machine that prints words poorly. His consciousness is an act directed by structuration, an act troubled less by the erasure of material traces than by the pathological state of his auxiliary psychic habits of structuration.

What gives rise to this misleading impression, and to the belief that material traces in themselves are sufficient, is the fact that it is possible to substitute the playing of the record for the presence of the orator. The banal dynamism of the phonograph's spring is the only thing required in addition to the structure of grooves on the record. Likewise, as Penfield's experiments have shown, the application of an electrode to the temporal lobe of certain epileptics seems sufficient to reactivate a sort of memory and an automatic recitation.¹⁷ If active consciousness was really like this, then the mnemonic act would be a simple amorphous force analogous to the force of the phonograph's spring. All it would seem to possess in terms of structuration would in reality be given to it by the structure of the traces, that it would simply put into motion once more.

In what other way could consciousness be capable of improvising and "forming"? A conscious theme is not amorphous. It is structuring, but is already and by itself structured, in the sense that it includes a *formal* intention that action only refines. Memory is essentially psychological, and the material traces can be nothing more than auxiliary. A mnemonic theme is an ideal theme whose first actualisation has, through repetition, already been given a precise form. To claim the contrary is to return once again to the theory of pure functioning.

Suppose we were tempted to respond that, after all, it is not clear why we would transform what we claim to demonstrate into a postulate. Suppose we accept the notion of a pure cerebral functioning for psychological memory. And suppose we were to go as far as admitting that, when the aphasic babbles, one part of the material brain reads another part of the same brain where the mnemonic traces are printed, however badly. What will we have gained? Absolutely nothing—for if we pass from psychological memory to organic memory, we will no longer be able to pretend that mnemonic consciousness can be reduced to the functioning of material traces through banal and mechanical reactivation. If a banal induction of nervous circulations in the adult brain under a faradic current may seem sufficient to

make it “speak” its memories, this is already enough to rule out the claim that the formation of the brain, from the egg to the newborn, could be a similarly simple reactivation of structures readymade in the egg. We cannot claim today that the egg, with its genes and protoplasm, contains—like a kind of “written plan,” or like the record that only needs to be played—all the future forms of the adult organism and its nervous system. The whole of experimental embryology, and all the studies of instinct, prove that formational dynamic themes are truly formational and organisational. They do not simply deploy structures, make structures “speak,” since these structures do not yet exist, and since it is precisely the formational themes that give birth to them. The embryo constructs itself through the coordinated actualisation of a whole, non-spatial architecture of themes that is at once formational and already informed. The problems of embryonic formation are always essentially “vertical,” like the problems of aphasia. They manifest themselves through condensations, agglutinations, duplications, preservations, abnormal developmental arrests—in short, through a gruelling transition into the space of non-spatial themes.

THE NATURE OF MATERIAL TRACES

The duality of the mnemonic effects of actualization—material and psychological, spatial and trans-spatial—to which we had given provisory status is only apparent. Far from reducing everything to material traces, as the theory of functioning asserts, it is the material traces and spatial modifications that are reduced, in the final analysis, to thematic and trans-spatial modifications.

‘Material’ cerebral traces are supposed to be inscribed in the structure of cortical proteins, and conserved by inertia against the passage of time. However, it can be shown, through a very simple calculation using results acquired through the method of ‘isotopic marking’, that a protein molecule has an average life-span of several days. Proteins are ceaselessly destroyed and reformed. What is more—as we know in the wake of modern chemistry—even over the same period, the subsistence of the molecule is in no way the mechanical inertia of a structure, but an active persistence according to the rules of actualization and spatialisation. We cannot therefore assimilate the traces eventually ‘borne’ by these molecules to the letters engraved in marble by a sculptor. Even if proteins reproduce, before disappearing, their exact double, traces included, the molecules bearing these traces are not equivalent to those fossils in which primitive organisms no longer subsist other than as petrified forms. Material traces in the ordinary sense

of the word—grooves in the wax, or letters in marble—are only the secondary, solid effect encountered in our experience. Moreover all material inertia is also only a secondary effect. The molecules of the wax or marble bearing ‘traces’ are themselves also active structurations. Just like organic proteins, their apparently inert structure depends on an actualization, on a process always underway. It is primary memory, the trans-spatial subsistence of themes in activity, which creates the brute appearance of material inertia and the space-time of functioning as a secondary and statistical effect. It is actualization, inventive or mnemonic, and not the functioning of the past, which makes the present. The desire to explain the subsistence of forms through inertia is like wishing to explain the continuous activity of an atom through the inertia of a billiard ball.

In practical terms, we can speak of the material ‘traces’ left by an actualization on a material, conceived of as completely homogenous, when the trans-spatial theme of the formation is considered with respect to its *terminal* effects. The orator speaks before a tape recorder. As she speaks, according to a theme signifying the whole [*ensemble*], she puts into play linguistic schemata and auxiliary motor schemata (already informed by preceding expressive efforts) in a cascade of improvised determinations analogous to the cascading determinations in embryogenesis. The thematic form of her intentions results, in the end, in modifications to a magnetic metal—in other words, in a modification of molecular relations. These modifications, for a modern chemist, are also modifications of atomic and inter-atomic ‘activities’, but roughly speaking and in practical terms, we can treat them as structural traces. The narrator’s expressive effort has, along the way—in the vertical architecture of the trans-spatial—mnemonic effects on linguistic schemata. When we speak, vibrations are produced in the air, but also and in the first instance, we learn to speak, creating partial ensembles better suited to expression in general. Terminal, so-called ‘material’, modifications on the tape recorder or the nervous tissue are not fundamentally anything other than a kind of mnemonic modification of the linguistic and psychological schemata. But because they occur at the end, we can for all intents and purposes take them as the spatial modification of a plastic matter.

Yet we must not be misled by this simplified way of presenting things, and be taken in by the illusion of reducing the subsistence of the real to spatial inertia, even though this inertia is only a limit idealization. Embryology also results in physico-chemical phenomenon and seems to be reducible to them. But in this case, the illusion is more difficult to maintain—even though the blindness of biases can

uphold it—due to the enormous gap between the point of departure and the point of arrival. It is difficult to convince those who want to reduce the memory of the orator to the material traces in her brain. The brain is so much more complicated than we are capable of imagining it to be. It should not be difficult to argue that the memory by which an egg becomes a human being is irreducible to material traces in the egg, and that it implies a whole architecture of trans-spatial themes in which the egg, and then the embryo, are only the spatial (or quasi-spatial) fulcrum, modified throughout their evocation.

THE PYRAMID OF FORMS

At the end of this investigation into morphogenesis, we therefore find it necessary to admit a kind of non-geometric dimension containing formational themes. ‘Verticalism’ is not simply a metaphor. These themes regulate the incessant activity that makes life. Just as psychological consciousness is always an effort according to an ideal sense, an effort which is translated by psycho-physiological ensembles themselves never completely imitable to the mechanical ensembles of automatism, formative consciousness is always an effort according to themes, making it more stereotypical and mnemonic in character, but without it becoming any less ideal and trans-spatial.

The economy of hypotheses is a good thing. The perseverance of biologists in explaining formation by physico-chemical phenomena is admirable. But the virtue of economy can be pushed too far, and at times reveals only a lack of imagination. He who persists in making four equilateral triangles with six match-sticks laid flat on a table without thinking about arranging them in a tetrahedron has also achieved an economical, if misguided, solution.

In all of the domains in which complex, organic or para-organic forms are found, it is remarkable that the pyramid of forms seems set down on its apex. Written language rests on twenty four letters and a few dozen signs; the most complex sentences and speech always come down to a few dozen fundamental sounds; music rests on a handful of notes. In the nervous system, the most complicated actions and shrewdest maneuvers always come down to the same few muscular commands. In the same way, the most elaborate calculator comes down to a play of elementary electrical impulses that substitute zero for one, and one for zero. More generally, the unbelievable variety of phenomena in the entire universe is always reduced in the end to the displacement and rearrangement of the same el-

elementary particles—electrons, neutrons, neutrinos. It is truly inconceivable that the whole pyramid is accounted for by its apex, by the movements of particles in space, and that the greatest masterpieces, in nature as well as in art, are only ‘an alphabet in disorder’.¹⁸ For the pyramid to hold, we require a proper consciousness of forms.

MORPHOGENESIS AND REASON

To explain all forms (whether of types I, II or III) by the zero form, in a fashion more or less renewed by Democritus—which is to say, by the fundamental disorder of atoms or elements—is in every way excluded by modern science, which only recognizes derivative phenomena in the zero form, in statistical molecular agitation, and in the equilibriums and laws of classical physics. The subsistence of forms I, II or III can only depend on a direct relation with an domain of order.¹⁹

If we try to understand organic morphogenesis *in general terms*—leaving aside for the moment the detail of scientific explication, like someone listening to a speaker without also thinking about the sounds that are being uttered, or like the user of a machine tries to roughly understand the role of its parts without following in detail its processes of realization—we clearly grasp *a reason* in forms. For example, we see clearly that every organism must use sources of energy like a machine. We see clearly the reason why respiration, in a higher-order multi-cellular organism, requires a more complex system of channels than the respiration of a protozoon; we see why the respiratory system of an insect can be simpler than that of a mammal, and why the heart of a mouse or a sparrow must beat faster than the heart of an elephant. We see clearly the reasons for the organs of photosynthesis in plants. We see the reason why a plant can and must have a mode of growth very different from that of an animal, with solidified parts which no longer develop, and specialized parts that ensure ongoing growth. We also see the general reason which presides over the diverse systems of organic or inter-organic coordination, in cellular societies and animal or human societies. In short, organic forms are intelligible in their general technique, which is troubled by the same problems and often finds the same solutions as the more lucid and more self-aware human technique. Long before we had formulated a definition of cybernetics, we had come to realize that organic techniques could inspire industrial techniques, and that the progress of industrial techniques could allow for a better comprehension of organic techniques. All the forms, whether of type I, II, or III appear to depend on the same Reason.

But what is mysterious is the way in which diverse kinds of beings could attain this Reason. In order to advance their technology and perfect the forms of their industrial machinery, civilised human societies are required to create research departments and organize scientific research. Where are the research departments and the CNRS²⁰ of organisms? Yet even before human laboratories, organisms discovered flight, electric batteries, calculators, ultra-sound, and so on.

The same applies to the problem of organic invention in general, as it does to the problems of vision, locomotion and manipulation. As a result of a strange anthropomorphic naivety, we believe that technical invention is natural and explicable if it is due to a human being, if there is a professional inventor endowed with a good brain and working in a subsidized laboratory. A technical invention in an organism, without a professional scientist or a research laboratory, appears mysterious and paradoxical, and we see no other reasonable solution than to attribute it entirely to chance mutation.

This is to simply forget that the human brain which invents itself is first of all only an organic tissue, a network of cells, and that *every human and social deployment of invention is only auxiliary and accessory*. In the human invention of the radar or flight, everything rests in the end on the auto-conduction of some cells of grey matter, in which and according to a research theme, the instructions for assembly must have been combined in themselves.

‘How can a cellular colony, without a brain, invent the rational and technical dispositions of the organism?’ The question is naïve. What is the brain, if not a colony or cellular network? The human who stands amazed before the organic inventions of an amoeba colony or an embryonic tissue simply forgets that his own inventions are themselves organic inventions and cortical cellular formations, subsequently transposed.

We leave to pseudo-rationalists the assertion that it is superstitious to believe in organic finality, and that finalist action can only be conceived in human psychology and thanks to the human brain. The broadly speaking rational character of morphogenesis is explained by the connecting up of every organic domain with the world of trans-spatial themes. Forms-I are just as connected up with the themes as Forms-II and Forms-III. Or rather, Forms-II and -III are only connected up with the themes because they are particular cases of Form-I. The human is only conscious, intelligent and inventive because all living individuality is

conscious, intelligent and inventive.

THE HOMOGENEITY OF INTELLIGENCE

There is a fundamental homogeneity of consciousness, intelligence, finality and the capacities for generalization and abstraction in all organisms, according to a sense. These features belong in an essential fashion to all true forms. Each and every organic individuality, in the broadest sense of the word, is not only an absolute surface in possession of itself, a field of conscious, but also an inventive intelligence.

The psychologists who fabricate so-called IQ tests run into serious difficulty every time they want to utilize them for culturally non-homogenous groups.

In applying, for example, the first versions of the Binet-Simon test to rural and urban boys and girls belonging to different social classes, the test's topics appeared to advantage boys of bourgeois parents, while disadvantaging city children. The same mental exercise, depending on whether it involves a marble or a doll, can appear easier for a boy or a girl. A test that asks what the word 'sonata' means is easier for bourgeois children than it is for a working-class child. In order to remedy this inconvenience, the tests are 'balanced', equalizing them until they no longer favour one particular group²¹—but then it becomes impossible to draw any conclusions about the intellectual equality or inequality of the tested groups. The same scores, for example, between boys and girls simply prove that the tests are well-balanced. Unequal scores do not necessarily prove that boys and girls are intellectually unequal, but perhaps just that the tests have been insufficiently balanced. It is more difficult yet again to attempt to make the tests, even those that are not language-based, what is called *culture free**. Drawings that represent a violin, a mechanical pencil, a pocket-knife, or a telephone would naturally be indecipherable for Melanesian children. Only topics supposed to be common across all cultures and trialed in diverse cultures can be used (*cross cultured tests**)—but the simple use of paper and crayons, or even the simple presentation of abstract marks without practical signification in a testing environment, favours or handicaps certain cultures.

It is easy to see how serious this situation is, not only with respect to the significance given to IQ tests, but to the very idea of intellectual difference. And in fact, if we follow this to its conclusion, we rediscover the same fundamental difficulty when we conduct experiments on the psyches of various animals. Broadly speaking, a chimpanzee appears to be more intelligent than a dog, and a dog more intelligent than a hen. But it would be necessary to run '*instinct-free*'* tests to actually decide. The chimpanzee has a hand, along with an instinct to hold onto branches,

along with its own instinctive ‘stick-age’. This handling of the stick gives humans the impression of intelligence, above all because it recalls a human gesture. The dog’s paw is incapable, for good reason, of such a performance—but does this prove that the dog is less intelligent, or only that the dog, in its ‘organic culture,’ in its instinctive ‘ethology,’ applies its intelligence at other points?

We can even go as far as the amoeba, which would be even more handicapped than the young Melanesian or by the pen and paper test. Would this be an absence of intelligence, though, or the lack of a certain ‘acquired content’ in its mode of organic culture? Is it more intelligent to walk with legs and eat with a mouth than it is to succeed at eating and walking without legs or a mouth, with only the appropriate deformations of a protoplasm? We might say that it is more intelligent to have developed, in the course of evolution, a handy set of legs and a mouth. But is this chance or skill? Chance and luck, which are absurd to invoke as replacements for consciousness and organic intelligence, are capable of explaining the *unequal satisfaction* of organic intelligence as it comes to grips with different milieus and circumstances. Ethnologists hesitate to link intellectual inequality to the ‘inequalities’ of human cultures, since they perceive all too well the differences in directions of application. Likewise, the belief in the greater intelligence of a particular human being is, in most cases, pure class prejudice, this intelligence simply being applied to a broader scale or a more specific material. A cabinet minister does not have to make a greater intellectual effort in balancing a budget of hundreds of billions than a mayor does in regulating the spending of his town. A manual labourer would have been able to become a laboratory scientist if he had applied his intelligence to different objects. It is not in principle any more difficult to find a conclusion to a syllogism when it bears on atoms or electrons than when it bears on marbles, even though it is a fact, as experience shows, that a subject little familiar with a certain ‘material’ of reasoning allows himself be disconcerted by it. We all have, in the same way, what could be called a ‘species prejudice’, a biological prejudice. The least civilized, including many primitive humans beings, consider, with a wisdom worthy of Montaigne, the animals they hunt to be beings as cunning as humans, but in possession of different habits. Not only Montaigne, but also the psychologists of instinct, who today engage in ‘comparative ethology’ and who consider cross-sections of animal and human cultures on the same level [*plan*] are our precursors here.²²

What gives the thesis of the homogeneity of intelligence a falsely paradoxical, and even purely fictional appearance, is, of course, that which interests the research-

ers as it does those who employ humans or animals—namely the genuine, actual or quasi-actual capacities of individuals and species. Now, however, the worker who would have been able to become a laboratory scientist cannot do so any longer. The chimpanzee is capable of performances of which cats and dogs are not. It is *practically* impossible to disassociate intelligent activity from its habits of application. But for the general problem of formation—our problem—this paradox is truth itself. As C.T. Morgan emphasizes, the capacity of generalisation, of reaction ‘to what appears similar’ can be observed in animals located right at the bottom of the phylogenetic ladder, and ‘in this respect, there has been no essential change throughout phylogenesis.’²³

Given Spearman’s g factor—that is, given the characteristic capacity of intelligence and cerebral consciousness to pass from given terms to the relation that unites them, or from a term and a given relation to a second term united to the first by the relation²⁴—we can discern a general organic capacity that we can dub the ‘*gamma* factor’, which is not only ‘noegenetic,’ but ‘morphogenetic’, and which acts according to the same laws. What is reproduction, regeneration, and the characteristic equipotentiality of all life, if not the capacity to ‘generalize,’ to act according to the similar or the thematic, rather than according to pure causes? Since, as we have noted, even the reproduction of a virus or a protein cannot be a mechanical molding, it must rather be an ‘eduction of correlates,’ indissolubly both morpho- and noe-genesis.²⁵

We have thus only been able to rediscover our fundamental conclusion, and the identification of formation and consciousness. We must not forget Spearman’s two principles—‘eduction of relations,’ and ‘eduction of correlates,’—themselves dependent on a first principle, that he rightly calls the ‘principle of consciousness,’ or ‘the principle of the apprehension of experience’²⁶: ‘All lived experience tends to immediately evoke a knowledge [*connaissance*] of its character, and an experiencing ‘I.’” This is to say that consciousness and life are one.

METAPHYSICAL EPIGENESIS

To recognize the homogeneity of consciousness or intelligence throughout the domain of life is not to add an adventurous metaphysics to a study that desired to stay as close as possible to scientific evidence, but rather to gain the means to respond to a last and apparently serious difficulty. By rejecting the false idea of functioning we reject all preformism. But by invoking a trans-spatial thematism

are we not lead to replace a mechanical preformism with a metaphysical preformism, simply placing the models of form outside of space instead of looking for them within it? The response can be drawn from human experience, since it is homogenous with all organic consciousness. The experience of technology or art clearly shows that morphogenesis through human intervention is guided by ideas, by glimpses of the possible or harrowing experiences of the impossible, while being in no way copied from a model. The inventor knows in general terms what she wants—what Claparède aptly calls guided invention—but she cannot read the details of the form of what is to be created in herself or in the heavens, but must engage in trial and error. By analogy with the radio, we desired the television, glimpsing its possibility and suspecting which lines of research would be involved, but its model existed nowhere—no more in the Platonic heavens than in our space. The guide of consciousness or active intelligence is not an Engineer or a transcendent Architect.

It is precisely the human experience of invention that forecloses the possibility of deriving any form of anthropomorphism from the principle of creation and organic morphogenesis. The prophet or the guilty sinner freely imagine a kind of Super-man, hanging over them, who speaks to or threatens them. But the inventor or artist, the creator of forms, believes in a standard of success and even inspiration, while nonetheless knowing very well that this inspiration is not, in an event, whispered to them from the wings. It is he and no-one else who must correct, re-touch, eliminate the faults of the work, and laboriously draw near to the idea that he wants to incarnate in it. And it is also he who must profit from strokes of good fortune by noticing and preserving them. This fundamental approach remains unchanged when we pass from human to organic invention, from psychological noegenesis to organic morphogenesis. The organism too forms itself amidst risk and peril; it is not formed. The differences between them, as considerable as they are, do not bear on the essential. They concern, on the one hand, the more mnemonic character of organogenesis, such that it resembles the filling-in of a crossword puzzle. The puzzle's author, rediscovering the grid and the list of questions created earlier, applies them now anew in order to resolve her own set of questions. On the other hand, they concern what the organism fabricates directly and does not—like *homo faber*—have to transfer its 'fabrication', through the cerebral relays, into an extra-organic matter. The living being is at once the agent and the 'material' of its own action. It is identical to brain tissue which would not have had to play the role of a first relay in an extra-organic realization, and which is self-sufficient. The living being forms itself directly in accordance with a theme,

without the theme first having to become an idea-image or represented model.

The difference between morphogenesis and noegenesis is in the end superficial. The living being forms itself just as the psychological idea forms itself in us, if not in the way the idea is subsequently realized with our hands. The true human experience of invention, true invention, that of the idea as such, frees itself from analysis and takes place through a direct actualization. To cite the poet:

*Even an artist knows that his work was never in his mind.
He could never have thought it before it happened.*27*

Invention is guided by a theme, it does not proceed by chance. But to conceive this trans-spatial theme as a model to be copied—in invention or morphogenesis—would be to be duped by the completely secondary and particular character of human invention.

Morphogenesis is neither the work of a copyist nor a pure active force. Correlatively, its directive Logos is not the patternmaker of a grand couturier or the creator of mechanical robots. It is in fact a non-spatial order, an unformulated yet effective ideal, a guide to activity indissociable from this activity itself. It does not keep for itself all real being, leaving forms to be mere copies; neither is it a pure illusory Nothing. The reality of organisms and of actual beings presupposes a non-Parmenidean being. An action, or an authentic formation, escapes from the Parmenidean dilemma of being and non-being. Being, opposed to non-being, cannot characterize an ‘active being’ since an ‘active being’ is by definition striving to be but *is not* [*cherche à être et n’est pas*]. If it purely and simply was, it would not act. Being, opposed to non-being, can no longer characterize the directing ideal, the theme of an as yet unformed form. If it was, it would no longer have the need for an active actualization. Only the set “theme -> form” is. To separate one term from the other is to condemn them both to vanish. Active, thematic formation alone is. Its conventional decomposition into ‘pure theme’ and ‘pure form’ leaves nothing but two shadows. To cite Lawrence once again in response:

*Even the mind of God can only imagine
Those things that have become themselves.*

NOTES

1. The translators would like to thank Rowman Littlefield International, and Sarah Campbell, in particular, for their support and the permission to publish this extract, and Flammarion for granting the rights for the translation.
2. Joseph Henry Woodger, *Biological principles* (London: Kegan Paul, 1929), 349.
3. Cf. J. Needham, *Biochemistry and morphogenesis* (Cambridge: Cambridge University Press, 1942), 139. TN: gastrulation is an early moment in embryogenesis, during which the initial surface formation of the embryo (the blastoderm, see note 14 below) further develops into a three-layered structure (ectoderm, mesoderm, and endoderm).
4. TN. Mainstream embryology claims that the various parts of the adult organism appear very early as zones within the developing embryo, and together form a ‘mosaic’. For Ruyer, this an overly abstract picture of development. It not only presumes that no extrinsic factor will come into play, it obscures the active dynamism that in fact characterises embryogenesis.
5. Woodger, *Biological principles*, 351.
6. Cf. *La pragmatologie* (Bruxelles: Parthénon, 1955).
7. TN. By using stop motion techniques, this film (which Ruyer makes frequent reference to throughout *La genèse*) makes it appear that Picasso’s works are painting themselves.
8. TN. Ruyer is referring here to the etymology of the word *cybernetics* itself, which comes from the Greek root *kybernetes* (steersman, guide, governor), and until quite recently, the word *cybernétique* denoted the art of governing. Its contemporary use began with Norbert Weiner’s *Cybernetics: Or Control and Communication in the Animal and the Machine* (Minneapolis: MIT Press, 1948). On this point, see also Ruyer *La cybernétique et l’origine de l’information* (Paris: Flammarion, 1954)
9. John Carew Eccles, *The neuro-physiological basis of man* (Oxford: Oxford University Press, 1953). We do not follow Eccles when he invokes Rhine’s suspect experiments and his “telekinesis” to materialise this will as a real force, applying it to neurons as it is applied to any other object such as dice or playing cards. An idea, a theme of action, is dynamic in the present through the systemic unity that it gives birth to in the organic domain in which it is the trans-spatial correlative, but it does not come to bear on energy anymore than it does on matter. Consciousness is dynamic without being a particular form of energy. Its dynamism is borrowed from the individualities that it unifies. It is indivisible energy which is born in the attenuation of individuality of the constituents of the system. What appears to the physicist as bonding through energy exchange is nothing other than an elementary field of consciousness.
10. Eccles, *The neuro-physiological basis of man*, 277.
11. Cf. also A.F. Adrian, *The physical background of perception* (Oxford: Clarendon Press, 1947), and Alfred Fessard, “Mechanisms of Nervous Integration and Conscious Experience,” in Jean-François Delafresne (ed.) *Brain mechanisms and consciousness* (Blackwell: Oxford, 1954), 229.
12. TN. Horse and horses are translations of Ruyer’s archaic *Cabaleité* and *cabaliser*.
13. TN. The blastula stage is an early moment in embryogenesis, during which the cells polarize into an exterior (blastoderm) and interior (embryoblast).
14. R.S. Lillie, *General Biology and the Philosophy of Organism* (Chicago: University of Chicago Press, 1945), passim, especially chapter 12. We have also emphasised this point—see Raymond Ruyer, *Éléments de la psycho-biologie*, 109ff.
15. Lillie, *General Biology*, 161.
16. Lillie, *General Biology*, 96 and 164.
17. Penfield’s observations have often been quite “embellished” in second-hand accounts. Penfield

notes that an “applied stimulation to what seems to be the same point of the cortex can produce an entirely different memory.” The memories evoked are, most importantly, thematic and not stereotypical. It is in this way alone that a patient expresses himself under the electric stimulation: “There it is. It was like witchcraft. HE was in the process of doing this, he snatched something from someone... a stick, or something.. At the top of the road...” (The patient had an epileptic seizure each time he witnessed someone snatching something from someone—under the guise of a childhood memory when he had snatched a stick from a dog). See Delafresneye (ed.), *Brain mechanisms and consciousness*, 296-7.

18. TN. This is part of a famous remark made by Jean Cocteau: ‘the greatest literary masterpiece is no more than an alphabet in disorder.’

19. TN. In the preceding chapter of *La genèse*, Ruyer presents a tripartite taxonomy of genuine beings, roughly corresponding to the divisions between the inorganic, the organic, and the psychic. In this passage, he briefly reiterates his argument that there is no form zero, which would consist of the smallest brute blocks of inanimate matter. For Ruyer, this level of reality does not exist. The ‘most basic’ forms, for instance a carbon atom, are not inert building blocks but already transpatial self-surveying forms. What classical physics took to be the building blocks of reality are only Forms I grasped from the secondary perspective of their aggregate behaviour.

20. TN. The Centre National de la Recherche Scientifique (CNRS) is the major State-funded scientific research institute in France, founded in 1939.

21. Anne Anastasi, *Psychological testing*, 6th ed. (Englewood Cliffs, NJ: Prentice Hall, 1990 [1955]), 169 and 255.

22. Cf. Tinbergen, *Etude de l’instinct* (Paris: Payot, 1971 [1953]) and *Social Behaviour in Animals* (London: Methuen, 1953)

23. Clifford T. Morgan, *Physiological Psychology* (New York: McGraw-Hill, 1943 [1941]), 144 [French pagination].

24. Spearman, *The nature of intelligence and the Principles of Cognition* (London: MacMillan, 1923). Specialists in IQ tests today vigorously criticize the ‘g factor’ and the notion of general intelligence. But the lack of practical interest in the notion is related precisely to its universality. The *g* or *gamma* factor is present in all living beings and cannot be used to discriminate between them.

25. TN. For Spearman, noegenesis is the inferential capacity that allows for the acquisition of new information through observation and through the combination of what is currently known.

26. Spearman, *The nature of intelligence*, chapter 4.

27. DH Lawrence, *Last Poems*. We borrow both this citation of Lawrence and the next from Leone Vivante’s in-depth study in *A Philosophy of Potentiality* (London: Routledge and Kegan Paul, 1955).