Essay in Formal Biology

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> The philosopher must twist and turn about so as to pass by the mathematical problems, and not run up against one,—which would have to be solved before he could go further. . . .
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> Even 500 years ago a philosophy of mathematics was possible, a philosophy of what mathematics was then.
>
> Ludwig Wittgenstein (1956, IV, § 52)

1. Opening

The task of this essay is to put biological individuals in formal terms. This approach is not directly interested in matters of time (for example, in evolution), but rather in the formal shape of biological objects.[1] So it is radically different from natural science. In his later years, Wittgenstein made similar investigations in psychology and mathematics.[2] Unfortunately, he found no time to make extensive remarks on philosophy of biology. This is what we are going to advance here.

The approach followed in this essay opposes, above all, the intensionalism in the philosophy of biology. A typical case of biologically motivated intensionalism is the theory of "organic wholes" adopted, among others, by one of the founding fathers of analytic philosophy, G. E. Moore. The most radical form of intensionalism, however, is vitalism. Vitalism, which is as old as biology is, contends that compared to the elements of matter, biological individuals contain elements which are of a fundamentally different kind. This conception was already embraced by Aristotle who introduced the concept of "final cause" which is to be kept apart from the material cause.

The most radical form of vitalism was developed in German Philosophy, first, in the eighteenth century by Leibniz and his followers. In the nineteenth century, Nietzsche

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[1] An ontological (structuralist) concept of the biological kinds, which doesn't necessarily oppose Darwin's theory of evolution, was suggested by D. W. Thompson (1917); see also Rescher (2011). On the compatibility of the formal biology with the mainstream theory of evolution see § 22.

[2] See the motto for this essay.

maintained that life is much stronger than knowledge (1874, § 44). At the beginning of the twentieth century, Hans Driesch still explained the life of biological individuals with the help of the Aristotelian term of *entelechy*. This is a substantial entity, controlling all biological processes (Driesch 1905).

Our objective in this essay will be to tentatively estimate the possibilities of applying formal approach in biology, not to develop an explicit and strict formal biology. To this purpose, we shall briefly discuss three different approaches in formal biology.

2. Wittgenstein's Formal Biology

2.1. Wittgenstein's Material a priori

As cases of formal biology can be cited some ideas or, more precisely, hints of Bertrand Russell and Ludwig Wittgenstein. In "The Philosophy of Logical Atomism" (1918) Russell compared philosophical logic to zoology. According to him, logic investigates the " 'zoo' containing all the different forms that facts may have" (1956, p. 216). Our claim is that this conception of Russell has also its flip side: Zoology can be seen as logic. The task of the logic of zoology—and of biology in general—is to describe zoological/biological individuals in formal terms—in terms of their forms.

The conception of logical forms as biological individuals was implicitly developed, but in a rudimentary form, by Russell's pupil Wittgenstein. In *Remarks on the Foundations of Mathematics* the latter raised the question:

> But could one not study transformations of (e.g.) the forms of animals? But *how* 'study'? I mean: might it not be useful to pass transformations of animal shapes in review? And yet this would not be a branch of zoology.
>
> It would then be a mathematical proposition (e.g.), that this shape is derived from *this* one by way of *this* transformation. (The shapes and transformations being recognizable.) (1956, III, § 13)

According to this idea, geometrical figures, numbers, but also biological individuals, can be seen as shapes (forms) which can be studied by respective formal disciplines that describe their transformations. Importantly enough, Wittgenstein now is reluctant to call these formal

disciplines *logic* because is indignant at the all-embracing claims of this discipline. He made these claims when he wrote the *Tractatus*.

Formal biology, in particular, describes qualitative forms (*Gestalten*) of biological objects. Hence it is a type of morphology. Not a morphology of Goethe's type, however. Wittgenstein's philosophical morphology tries to find the forms of the individuals with the only aim to analyze and discuss them. In contrast, Goethe's morphology is not analytical (not formal) but complementary. It is a kind of natural science—a suggested alternative to the science of Isaac Newton.

Here is a brief description of Wittgenstein's approach:

> Wittgenstein sees the task of elucidating here, above all, as to put of the data together [*zusammenstellen*]; the data are to be so put together that to suggests an understanding. ... In this way he suggests a 'general picture' of the data, which presents them perspicuously, without to pay attention to their temporal order. (Schulte 1990, p. 32)

Now, it is exactly this seeking of new formal orders of biological individuals, that suggests new *patterns* of individuals that are the proper subject of this type of formal biology.

This approach is based on the understanding that biological individuals are mosaics of forms, so that at every instance—in every biological individual—we see the object in only one of its many forms; its other forms remain implicit.[3] The task of formal biology is to find out these forms. Its method is the comparison of the different forms of biological individuals (including that of "folk biology") that it collects in formal patterns of most variegated order. In contrast, mainstream biology is only interested in the spatial–temporal (in the real) orders of biological individuals.

Wittgenstein's formal biology is clearly a rich research program. It contrasts, the conventional taxonomies in biology, introduced into it by Carl von Linnaeus, are linear and so monotone. Also today, the mainstream taxonomies in biology are usually built on an inclusive relation of genus to an art. Their ideal is the *arbor Porphyriana* by which every new classification relates a genus to an art. Wittgenstein was sharply critical to it. In "Conversations with M. O'Drury", he noted: "I have always thought that Darwin was wrong:

[3] This conception is based on an idiosyncratic interpretation of the Wittgenstein's Tractarian objects, developed in Milkov (2001).

his theory doesn't account for all this variety of species. It hasn't the necessary multiplicity. (1981, p. 174)

Wittgenstein's description of biological individuals compares forms (shapes) of objects in order to pick out new patterns in which new forms of theirs are presented. An instructive example of this method is provided by Wittgenstein in *Remarks on the Philosophy of Psychology*:

> But might it not be that plants had been described in full detail, and then for the first time someone realized the analogies in their structure, analogies which had never been seen before? And so, that he establishes a new order among the descriptions. He says, e.g. 'compare this part, not with this one, but rather with that' ... and in so doing he is not necessarily speaking of *derivation [Abstammung]*. (1980, § 950)

Despite the fact that Wittgenstein did not elucidate what this new discipline exactly is, he gave hints at how to develop parts of it when he introduced the concept of *forms* of life (*Lebensformen*). He uses this expression in an idiosyncratic way at that. For Wittgenstein, this term is a biological, not a social category. Thus he held that there is a man's form of life, lion's form of life, etc. In fact, every biological species has its own form of life. In contrast, in ordinary German, this concept means social, or spiritual *ways* of life, not biological forms of life. One maintains, for example, that different social classes in the nineteenth-century Germany had different *Lebensformen* (ways of life). This was the sense of the concept *Lebensformen* also according to the man who first introduced it in the theoretical humanities—Eduart Spranger (1914).

Comparing different forms of life is only one type of the patterns in formal biology. As already noticed, however, biological individuals have data of different order. So we can investigate different orders of biological forms (shapes):

(i) The outer form of the animals. "Are tomatoes fruits of vegetables?" "Is a zebra without strips a zebra?"—all Wittgenstein's questions!

(ii) Animals' behavior (*habitus*) understood as a form;

(iii) The animals' psychology: what animals strive for, hope for, dream for, etc.

Etc.

These different kinds of investigations give rise of different kinds of formal biology. At the end we have descriptions of different patterns of biological forms which can be ordered in separate chapters.

Importantly enough, these investigations are similar to that Wittgenstein made of colors in *Remarks of Colour*. Historically, it followed the approach of "pattern analysis," introduced in humanities by Oswald Spengler who compared the archetypes of different cultures (Haller 1988, pp. 74–89). These are analyses of data, of indefinables, of objects (faces, shapes) that cannot be analyzed further.[4] In *Philosophical Investigations* Wittgenstein analyzed this way the forms of: the fly (§§ 284, 309), goose (p. 221), hare (§§ 520, 521, 524, 542), dog (§§ 250, 357, 650, pp. 174, 229), beetle (§ 293), cat (§ 647), cow (§§ 120, 449, p. 220), lion (p. 223), mouse (§ 52), parrot (§ 344, 346), cat (§ 647). "They constitute an autonomous, natural order that is not capable of being invented or constructed through acts of man." (Smith 1992) In this sense, they are cases of material a priori.

2.2. Formal Ontology of Biological Objects

Formal ontology of biological individuals was also advanced by Nicolai Hartmann who held that the world is a united system, which nevertheless has many *strata*. The strata are ordered one onto another, so that each one "is not isolated in itself, but rather sets out the conditions and regularities for the next strata" (1940, p. 182). Every stratum of a higher order is a superstructure on the grounding stratum. Perhaps we can better understand this ontological dependence in the light of John Searle's conception that strata are not causally but ontologically dependent. The strata of higher order are only a trait of the strata of lower order (1983, pp. 20–1).

This position was also embraced by Karl Marx according to whom the subject is parasitic upon the world: it does not have anything else to do than to imitate reality.[5,6] The subject makes this in an attempt to "grasp" the world, to *assimilate* it, becoming in this way

[4] See Milkov (1999).

[5] The alternative positions, which accept that the subject can achieve something of his own, are necessarily circular. Take, for example, the conception that the subject's aim is to be "capable of making molecules swerve from their paths" (Searle 1984, p. 92). It again assumes an action *upon* the world and not independent of it.

[6] A similar position was maintained by Wittgenstein. We are going to discuss it in § 3.1.

identical with it.[7] As Marx put it—following Aristotle, via Hegel,—the subject makes this in an act of "appropriating of alienated, objectivated essence" (1974, p. 242).

As for their uniformity, in our formal ontology we hold that biological individuals are different developments of one and the same form of nature (see Thompson 1907). We follow in this a long tradition in searching for a uniform ontology in biology and philosophy of mind. Two examples: (i) Nietzsche claimed that thinking has its primitive stages in the pre-organic world. " 'Thinking' in primitive states (pre-organic) is forming on—so as it is by the crystals." (1901, § 499) (ii) The same did Bertrand Russell who claimed that "lifeless instruments, such as photographic plates and gramophones … have something closely analogous to perception" (1927, p. 270).

The acceptance of the uniformity of the nature of biological individuals paves the way for elaborating a powerful formal ontology in biology. We, more precisely, can see different ontological individuals as constructed out of simple forms, through their modifications and different arrangements.

According to this conception, different kinds of organic individuals, plants, animals, *homini sapienti* and their thinking, are results of different *ways* of composing complexes which can be described by logical means. In order to demonstrate this, we will refer to our investigations in Wittgenstein's Tractarian ontology.[8] According to them:

(i) The objects are arranged in complexes, fitting one to another in certain *way*.

(ii) By picturing, the forms of facts are delivered (*expressed*) by other facts (pictures)—in a certain way (style). Importantly enough, the form of projecting hinges on the form of facts.

(iii) The copying (deliverance) of facts by thinking is the way of projecting the facts through language.

(iv) Creating (gestures, postures, etc.) is also an act of delivering of forms in a certain way. This time, however, the act of projecting (expressing) changes the form completely so that a new form is created.

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[7] In this sense, Konrad Lorenz states that biological individuals make pictures (*Abbildungen*) of the real world, which are similar to a plaster copy of a coin (1973, p. 39).

[8] As developed in Milkov (1997, i, pp. 372–4; 2003: ch 3, § 3, (vi); and in the chapter "Wittgenstein's Ways" in this volume.

Our final thesis is that not only the different strata of the world, but also the strata of biological objects, can be logically constructed and also explained in this way. Accordingly, our formal ontology of biological individuals describes the different ways in which biological individuals are composed.

Our hope is that the formal ontology of biological objects we are suggesting in reference to Wittgenstein puts many points of both contemporary biology and contemporary philosophy in a new light. Take as an example biological evolution. Our formal ontology describes it as accomplished in accordance with the laws of composition of complexes. This conception is supported by the mainstream evolutionary biology today, which maintains that the change in the life-world is a result of gene mutations. In fact, the genes can be seen as nothing but forms (from a logical point of view, they can be seen as the identification numbers of the biological objects) that are quasi "attached" to some of their building-blocks-chromosomes. On this view, the natural selection consists in that only those individuals survive that have more developed forms. Importantly enough, the "development" here is understood in terms of information.[9] In other words, these types of individuals survive that have better information-gain (Lorenz 1973, p. 38).[10]

This conception of the species-evolution maintains that there is no place for teleology in it but for abundance of forms and their subsequent combination. In this variety, the winner is contingent. So Daniel Dennett: "Replication is not necessarily for the good of anything. Replicators flourish that are good at ... replicating." (1990, p. 129) The selection among the forms takes place in a process of ceaseless experiments, through a constant confrontation with the forms of reality. The method is that of experimenting and correcting. The neo-Darwinian Richard Dawkins sets out as necessary conditions for the biological evolution via natural selection three factors:

(i) Abundance of most variegated elements;

(ii) The elements must be able to copy themselves;

(iii) Interaction between the form of the elements and the form of environments (Dawkins 1976, p. 127).

[9] Karl Popper's "evolutionary epistemology" (1984) maintains virtually the same.

[10] Here it is to remember that the etymology of the concept of information is connected with the concept of *form*.

3. Mereology of Biological Individuals

3.1. Wittgenstein's Biological Mereology

Mereology is a well-established approach in philosophy of biology, already use by Aristotle in *De partibus animalium* and also by the Stoics. In modern times, Joachim Jungius, Gottfried Leibniz and Bernard Bolzano made important contributions to mereology. But mereology was also widely explored in early analytic philosophy, for example in Wittgenstein's conceptual analyses as developed in the last pages of the *Notebooks 1914–1916*.

According to Wittgenstein,[11] the subject and the world are separated one from another; they are independent one from another and are self-contained. In another sense, however, the subject is compelled to imitate the world in attempts to grasp it—to become identical with it. The aim is to quasi abolish the difference between the person and the world. This relation is made either in the form of *contemplation*, or in a form of *creation*.

The very impulse to know the world comes out of the consciousness that we are unique subjects. "Only from the consciousness of the uniqueness of my life arise religion–science–art." (Wittgenstein 1979, p. 79) At that, the person and the world lie in two different planes. It is true that the impulse to know the world comes from the person. However, he doesn't exist in the plane of this knowledge: we cannot find it amongst the pictures made by him. "The subject does not belong to the world: rather, it is a limit of the world." (1922, 5.632) This explains why "solipsism, when its implications are followed out strictly, coincides with pure realism" (5.64).

All this means that there is in the world a thinking subject and also another willing subject, which are situated in two different planes. This means that they cannot be seen together in one and the same time. The volitional subject exists only as the cause of our knowledge. Unfortunately, very often it is extrapolated onto the world of ideas, thus producing confusions with important consequences. This mistake is easy to commit since the volitional subject is embedded in a body, which is a part of the material world.

3.2. Hegel's Mereology of Biological Individuals

[11] In the next paragraphs we follow Milkov 1997 i. pp. 381 ff.; see also Milkov (2004).

In *Philosophy of Nature* (Volume 3 of his *Encyclopedia of Philosophical Sciences*), Section Three ("Organics"), Hegel has made a bunch of interesting suggestions in the "logic" of biology. Hegel's "science of logic", however, like all classical logic before Frege, was built "within the bounds of a mereological idea of logic" (Stekeler-Weithofer 1992: 100). That is why his logic of biology is more of a mereology of biological objects. Unfortunately, so far this part of Hegel's philosophy remained in the shadow.

Hegel's biological mereology makes analyses similar to these of Wittgenstein as discussed above: it describes biological individuals in terms of wholes, their parts and their location. In what follows, we are going to set it out—indeed, only in rudimentary form,—but recovered from Hegel's speculations.

(a) Biological Individuals. To Hegel, only animals and humans are biological individuals. This is already shown in the fact that the flowers in our private garden have no proper names, whereas our pets have names. In order to mark off this difference, we can call, for convenience, the plants *particulars* and the animals *individuals*.

The fact that animals are individuals while plants are only particulars, explains why the former have, while the latter haven't:

- Self-expression: Animals express themselves through their voices; in persons this characteristic is further developed in language.
- Locomotion: Animals are not connected with one point in space as plants are connected; but they are nevertheless connected with some spatial point which they chose and which they occupy now.
- Senses: Animals have feelings: pain, joy, etc.; plants don't have feelings. [12]
- Souls: animals have souls, plants have not.

How are all these—and other—characteristics to be formally interpreted? Following Hegel, in the next sections we are going to give a tentative answer to this question.

(a) Shape (*Gestalt*). An organism has characteristically a *form* (*Gestalt*), which it reproduces in its biological successors. But while the plant "is still closely related to geometrical forms and crystalline regularity" (§ 345),[13] the form of the animal is something radically new. It is a biological form.

[12] *Pace* Gustav Theodor Fechner, who believed that plants have souls (1848).

[13] Here and in what follows the quotations are from Hegel (1970).

Another formal difference between plant and animal is that whereas plants mature through a change of form, animal's maturation involves a change in size, the animal's shape remains the same (§ 343). This point is another argument to hold that the plant is not an individual but a particular: it ceaselessly changes its outer individuality (see (e), below).

(b) Mereology of Biological Individuals. Organic individuals can be also seen as conventional unities that contain parts—the members (limbs) of the individuals. The difference between them can be well described as a difference in the set-up of unities:

- The members of plants are not related one to another.
- In animals, the members are related; they are elements of their unity—elements of their form. The members of animals are interchangeably means and ends (§ 355); indeed, they are perpetually negating their independence (§ 350).
- What is new with the human person is that he concentrates his power into a single point of his body, deploying it into certain direction, and for particular purposes.

(c) Sense. Most important characteristic of animals is their sentience: they have feelings. In fact, feeling is nothing but a form of connection of the biological individual with the world made from the perspective of its self-preservation (§ 344, *Add*.). This connection is realized through the stimuli produced by the individual that recurrently encounters matter. In other words, perception is stimulation by matter, and a reaction of self-preservation in the face of that stimulation (§ 354).

Senses are spatio–temporally determined. In sight, the physical reality manifests itself spatially; in listening, it does so temporally. This explains why in hearing, the object ceases to be a thing—it becomes a sound.

(d) Soul as self-reflexing. As already mentioned, a soul is characteristic of animals only. Plants do not have a soul. The soul can be defined as the self-reflexive sentience of a logically-defined individuality. This logical characteristic of the soul explains why it is not composite: it is an expression of the unity of the individual (§ 350, *Add*.); of "the incomposite existence of the unity of selfhood" (§ 344, *Add*.).

The animal in general is self-relating (self-referring)—but not self-reflexive—in the sense that it develops in two logical directions that have one crossing point. (In contrast, the chemical particles are one-dimensional). On the one hand, it follows the reality and in this

sense it is part of it. On the other hand, it is only one moving point of reality which is its center as an individual.[14,15]

(e) Relation to the External World. Animals and men are oriented towards externality in the same extent in which they are internally strung in opposition to it (§ 357). This means that individuals' opposing to reality is not absolute. Time and again, they realize that they are not self-sufficient. This happens in the relation of individuals' *reproduction* through the environment, from which they are split off. There are two such relations: of assimilation of nutrition, liquids, smoke; of sex. Both processes are cases of *consuming* (see Milkov 2011). The process begins with the awareness of deficiency, and the drive to overcome it (§ 359).

(i) Assimilation:

- The external nature to which the plant—the particular—relates is not individualized, but consists of elements which are mass particulars (§ 347). Its relation to the external nature is a transformation of one external material to another (§ 345).
- In contrast, when it interacts with the environment, the animal preserves its selfhood. It *feels* an unpleasant need (hunger) which is nothing but "a connectedness with the universal mechanism and abstract powers of the world" (§ 361). The aim is a satiation,[16] by which no deficiency is felt anymore. Now "the organism is objective" (§ 366).

(ii) Sex-relation: It is characteristic for animals only. In it, the animals are related one to another through their senses. This is so since "the genus is present in individual as an urge to attain its sentience in the other of its genus" (§ 368). In contrast, the plant is sexless; its sexual parts (organs) are not an integral part of its individuality (§ 347).

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[14] Helmut Plessner has expressed this point as follows. Organic individuals have a double reference, realized in two planes, determined by the boundaries of the individuals:

(i) They relate themselves to this boundary and so to the environment. This relation is reciprocal.

(ii) They relate self-referentially to themselves (1928, p. 181; see § 4.1).

[15] This point suggests a logical explanation of why the personal life is intrinsically paradoxical (see Milkov 2004).

[16] "Satiation" is also a term of Frege's logic which comes to denote the satisfying of a function through its argument. It was often translated as "saturation". For criticism see Milkov (2015).

(f) Genus as One Whole. Seen mereologically, one natural kind is one whole. Its different exemplars, the individuals, are only its elements. So in a sense, they are one thing; what differentiates them one from another are accidental factors: geographical, biographical, etc.

This means that the individuals of a genus have souls that are intrinsically identical one with another: they are numerically different, but qualitatively identical. To be more exact they all are exemplars of the one World Soul (*Weltseele*).[17] This explains why biological organism is a *microcosm* (§ 362, *Add*.).[18]

4. Topological Biology

4.1. A Reconstruction of Helmuth Plessner's Scheme

Another variant of formal biology was advanced by the German philosopher Helmuth Plessner (1892–1982). Plessner was a student of Edmund Husserl, Wilhelm Windelband and Max Weber and an admirer of Immanuel Kant and also of Hermann von Helmholz. Plessner was the first philosopher who pursued a formal biology in topological form in Germany, thus opposing the conception of his teacher Hans Driesch, the father of the neo-vitalism. In this section, we shall try to put his theory into new terminology. Our motive for doing so is that Plessner advanced his theory in 1928 in a German cultural environment. As a result, his terminology appears to the readers of today rather obscure. This partly explains why his topological biology is rather neglected today.

To put it briefly, the main idea of Plessner's topological biology "was to apprehend life in terms of the relation of the individual to its boundary". (Gerhardt 1998, p. 43) He assumed the *differentia specifica* of biological objects to be the fact that they have "positionality"—we shall call it a *location*—in space. Plessner thus presented biological objects as topological entities that are marked off from their environment through their boundary: the membrane that encloses the cell, the hide of the animals, the skin of man, etc. The important point is that the biological boundary belongs to the body. In contrast, mineral bodies merely have edges; the latter do not belong to the objects themselves.

Different strata of biological objects have quite different topologies:

[17] For this term used also in Wittgenstein (1979, p. 49e).

[18] "I am my world. (The microcosm.)" Wittgenstein (1922, 5.63)

(a) Plants' location (positionality) is open. This means that, despite being sharply determined by their boundaries, plants directly explore their environment.

(b) In contrast, the location (positionality) of animals is closed: they make their location a constitutional principle of their being. This means that they are organized around one point—more precisely, around one *figure*: the body of the animal that Plessner calls *center*. Accordingly, Plessner calls animals *centric* biological individuals. Animals live towards, and through, their individual form. But they are not this form: they are not individuals. This explains why despite the fact that they *experience* contents of the outer world (they have perceptions and experience), they do not experience their *personality*.

(c) Only man has personality. He does not only live out of its location (body); he also refers to his location.[19] That is why Plessner calls him *eccentric*. The most important consequence of this newly explored ontological dimension—developed into a new stratum of ontology—is that man experiences his experience. (This makes him self-reflexive, and also free.) In this way he trespasses his boundary and exactly in cultivating it, becomes what he is.[20] To be more exact, the man *makes* himself through his "life-acts":[21] the man constructs himself.[22] He becomes himself only referring to the objects of the external world (Plessner 1928, p. 17). It is this reflexive making of himself through reference to the external things that constitutes his *existence*.

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[19] An alternative topology of man and animal is set out by Karl Marx. According to him, while the animal forms its product according to the form and the need of the species to which it pertains, the man produces according to any species. The man knows how to lay out the form of any object (1974, p. 158).

[20] This theory is close to Aristotle's conception that the "thought thinks on itself because it ... becomes an object of thought in coming into contact with and thinking its objects" (*Met.*, 1072b19–20). Among other things, this conception was warmly embraced by Hegel who quoted this passage in a more extended form at the very end of his *Encyclopedia*. This point explains why some authors find Hegel's *Phenomenology of Spirit* a precedent for Plessner's project of formal biology (see Gerhardt 1998, p. 43b).

[21] This conception was initially developed by Wilhelm Dilthey in his book *Die Lebensakten der Menschen* (1907, p. 164). Cf. with the concept of speech-acts, developed around 1910 by Adolf Reinach and after the Second World War by J. L. Austin and John Searle.

[22] This conception strongly reminds John Searle's theory that social reality is constructed by the way of social acts (1995).

To put this point in other words, man is incomplete; he needs supplementation (is *ergänzungsbedürftig*) (ibid., p. 18);[23] and he finds his finite form only in culture. In fact, what we call *culture* is a result of just this characteristic of the human person (ibid., pp. 383 ff.). Ultimately, this is neither a result of his will to power (Nietzsche); nor a result of the *libido* (Freud). Rather, culture arises out of the incompleteness of the man from topological point of view.

(d) It is the existence that makes the common spiritual life of the humanity possible: the social life; the mind (*Geist*) as distinct from the individual consciousness or the personal soul (Plessner 1982, p. 15).

4.2. Alternative Biological Topologies

The topological approach was often used in philosophy of biology in the past. Already Aristotle has noted that "in some animals we find all such distinctions of parts as this of right and left clearly present, and in other some; but in plant only above and below" (*De caelo*, 284b15–17).

In a recent article Berit Brogaard and Barry Smith, following some ideas of Roman Ingarden, try to precisely define the beginning of human life (an issue of first-rate importance by discussing such issues of applied ethics as abortion) using the same topological approach. They fixed the beginning of human life at day 16 after the fertilization of the egg-cell by a sperm. Indeed, it is first the embryo, developed in the period of gastrulation, that is topologically a self-sufficient entity and which can be seen as an ontological individual. This is determined through: (i) its boundary; (ii) it being a unified causal system which is relatively isolated from its surroundings (Brogaard and Smith 2000, p. 15).

In contrast, the opposing conventional view that the threshold event in the making of a human being is to be located towards the end of the first trimester after the fertilizing of the egg-cell, refers to such a vague concept as the visible *resemblance* of the embryo to a human being.

4.3. Ecological Topology of Biological Individuals

[23] Another term also used by Gottlob Frege (see n. 15) but in quite different context. To him *ergänzungsbedürftig* are the function and its argument in logic.

A case for ontology of environments (*Umwelten*) or for ecological topology was first developed by the constructivist biology of Jakob von Uexküll. Uexküll claimed that every animal creates his own environmental reality. There are as many enclosing realities as there are animals; these worlds are, practically, as separated as Leibniz' monads are. Their "environments surround them like solid but invisible glass houses" (Uexküll 1928, p. 62). Since all organisms are embedded in their own niches, their forms (shapes) can be differentiated according to the forms of the niches: according to their exterior boundary. Apparently, Uexküll suggests an alternative—ecological—topology of biological individuals. In this section we are going to set out some of its points.[24]

(i) At one extreme we find the niches that are fully bounded by a retainer. This class can be subdivided into:

- Those whose retainers offer full protection without an access point: an example here is a larval cocoon;
- Those which have access point. Examples are: a closed oyster shell, which must actively keep its shell closed to prevent predators from prying it open. The degree of protection depends on the physical properties of the retainer. The walls of the crocodile's egg, for example, have a higher protective value that the thin membrane enclosing the mammalian zygote.

(ii) Most biological niches, however, are not fully bounded. Examples are: a kangaroo-pouch, a nest, a hive. All of these are niches which do not involve closed cavities but rather natural or artificial hollows within their respective environments. Nevertheless, from the perspective of protection it is fairly robust.

(iii) There are also niches which are bounded by a partial retainer which offers a low degree of protection. Example is the niche of the oxpecker removing ticks from the back of the African rhinoceros's hide, a niche bounded by a part of the rhinoceros's hide.

(iv) Finally, at the other extreme of the continuum between bound and free niches we find biological niches which lack a retainer altogether. Such niches are bubble-like zones in some region of space, as in the case of the niche of the fish of the open ocean. This class of niche may manifest a range of different topologies. So, for example, when a falcon is flying

[24] In this we follow Smith and Varzi (2001, pp. 235 f.)

in the sky circling above the area where its prey is to be found, the niche of the falcon is its orbit.

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