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Lecture 18: The Wider Calculus

Introduction

Last week, we looked at Deleuze's interpretation of the differential calculus. In particular, we focused on the way in which the calculus provided an alternative to the Kantian model of Ideas. As we saw, Kant provided an account of Ideas whereby they allowed the regulation of experience. Ideas provided absolute totalities which allowed reason to develop systematic knowledge. They were constituted by three moments: the indeterminate, the determinable, and complete determination. Now, Deleuze's critique of Kant essentially revolved around recognising that only one of these moments was actually intrinsic to the nature of the Idea (the indeterminate). The other two were extrinsically related to Ideas by analogy with objects that were given in experience. As such, while Ideas constituted a problem, this problem was still, for the most part, understood in terms of the solution they gave rise to (although it's probably fair to note that Kant isn't particularly interested in the genesis of experience, but rather with determining a priori truths on the basis of its structure).

Now, the calculus provided an alternative to the Kantian notion of an Idea. As we saw, we can find each of the three moments of Kant's Ideas in the calculus. The differentials, *dy* and *dx* are indeterminate on their own – they represent infinitesimal magnitudes that fall outside of representation, but nonetheless, when combined together are able to form ratios that do represent a determinate quantity (which allows us to work out the gradient of a curve). Rather than just giving a regulative model of experience, Deleuzian Ideas give us an account of the constitution of experience from elements that themselves fall outside of it. The natural question to ask about Deleuze's account of the calculus is, however, how do we apply it outside of the field of mathematics? As we shall see, Deleuze is not arguing that the differential calculus explains all forms of experience, but rather that for each specific domain of experience, there will be a form of calculus. In the process, Deleuze provides three examples of the calculus of Ideas in other domains: ancient atomism, comparative anatomy, and social theory. In each case, Deleuze's claim is that the phenomena in question are best understood as being structured by a field of elements that become determined by entering into reciprocal relations with one another. This model provides a sharp alternative to the Aristotelian account of determination where determination operates through attributing properties to a pre-existing subject. Rather, here the subject is constituted by elements that themselves do not have the structure of a subject. Before turning to this model, I want to talk a little about the way Ideas operate in different fields.

Ideas and the Wider Calculus

Deleuze makes the claim that 'differential calculus obviously belongs to mathematics, it is an entirely mathematical instrument. It would therefore seem difficult to see in it the Platonic evidence of a dialectic superior to mathematics.' (DR 226) This is a reference to Plato's analogy of the line, that we looked at earlier in the term. We saw that Plato held mathematics to be the second highest form of knowledge, below knowledge of Ideas themselves. It seems equally clear that Deleuze wants to provide an account of the world, not just of the field of mathematics, and so he will need a wider notion of calculus. In fact, once we recognise that problems are of a different order to solutions, we can note that mathematics is a way of representing solutions – 'what is mathematical (or physical, biological, psychical or sociological) are the solutions.' (DR 227) These domains do not apply to problems themselves. However, as problems are *expressed* in relation to (and within) solutions. The calculus is itself a way of providing symbols of difference, and as such, it is still propositional, and tied to a specific domain. As what these symbols refer to cannot be represented, however, the calculus points beyond itself to the problem itself. 'That is why the differential calculus belongs

entirely to mathematics, even at the very moment when it finds its sense in the revelation of a dialectic which points beyond mathematics.' (DR 227) What is important about the calculus is that it presents an account of how undetermined elements can become determinate through entering into reciprocal relations. As relations exist in domains outside of mathematics, the differential calculus 'has a wider universal sense in which it designates the composite universal whole that includes Problems or dialectical Ideas, the Scientific expression of problems, and the Establishment of fields of solution.' (DR 229)

As we have seen, Ideas are formed from the differential relations of their elements. In this sense, Deleuze claims that 'Ideas are multiplicities.' (DR 230) They are formed from the reciprocal relationships of elements that in themselves are indeterminate. Now, in this respect, they differ considerably from the kinds of multiplicities we normally encounter. When we are dealing with a spatial multiplicity, we think of a multiplicity as a structure possessing many elements. In this sense, we can call it an adjectival notion of multiplicity. The 'many' in this case is a way of describing substances that can be in a sense indifferent to being given the classification, 'many.' They are determinate before they form a group. So, we might say, 'there are many chairs in this room'. In doing so, we don't really add anything to the chairs themselves, but really impose on them an extrinsic form of organisation (we bring them under a concept). As we saw with Deleuze's Ideas, On the contrary, with differentials, they become determinate precisely by being reciprocally determined. Rather than multiplicity being an adjective that describes a group of substances, Deleuze claims that 'the multiple is the true substantive, substance itself.' (DR 230) As we have just seen, in order to conceive of the multiplicity in this way, we can't see it in terms of self-standing elements.

A question might, therefore be how we determine whether a multiplicity is an Idea, and in response to this, Deleuze gives three criteria for the emergence of Ideas. First, 'the elements of the multiplicity must have neither sensible form nor conceptual signification, nor, therefore, any assignable function.' (DR 231) That is, they must be determined through their relationships with one another, rather than prior to it. This clearly follows from the account of the problem solution complex, since if they were understood in sensible or conceptual terms, then they would be extrinsically defined by experience, rather than determining experience itself. Second, 'the elements must in effect be determined, but reciprocally, by reciprocal relations which allow no independence to subsist.' (DR 231) Finally, 'a differential *relation*, must be actualised in diverse spatio-temporal *relationships*, at the same time as its *elements* are actually incarnated in a variety of terms and forms.' (DR 231) That is, if the Idea is to provide some kind of explanation of the structure of the world, it must be applicable to more than one situation; it must capture relations in more than one domain. To explain how this account functions, Deleuze provides three examples of Ideas in non-mathematical fields: atomism as a physical Idea, the organism as a biological Idea, and social Ideas. I want to focus here on the second of them.

Ideas and the Structure of the Organism

I want to begin by looking at the classical account of the structure of the organism. This account is perhaps best embodied by the philosophers Aristotle and Kant, and the anatomist, Georges Cuvier. In one sense, we can, of course, see the basic building blocks of the organism to be the matter which constitutes it. Such an understanding of the organism will allow us to see the organism purely in mechanical terms as the mutual interactions of its parts. Although such an explanation appears to be a theoretical possibility, it suffers from the limitation that it appears to ignore two central features of the organism, that it is unified, and that it is organised. As these features appear to be essential determinations of the organism, if we are to give an account of them, we need to present an alternative explanatory framework which allows us to explain the structure of the organism. In his *Critique of Judgement*, Kant argues that a presupposition of our

enquiry into the natural world is that it is in some way comprehensible by the understanding.[i] Now, Kant argues that "since natural laws have their basis in our understanding, which prescribes to nature (though only according to the universal concept of it as a nature), the empirical laws must …be viewed in terms of such a unity as [they would have] if they too had been given by an understanding (even though not ours) so as to assist our cognitive powers by making possible a system of experience in terms of particular laws."[ii]

Kant's argument is therefore that seeing nature as something commensurate with the understanding implies our seeing nature as created by an understanding. With this move, we therefore open up a whole new category of descriptive concepts which can be applied to nature. If nature is seen as the creation of an understanding, we can view creatures in categories applied to other forms of intelligent creation, such as one would apply to the human creation of art or tools, where the final goal of the object enters into our understanding of the object itself. Thus, according to Kant, if we are to see nature as being commensurate with the understanding, we must see it as *purposive*.

What does this understanding of the organism as purposive entail? For Kant, "a thing exists as a natural purpose if it is *both cause and effect of itself*,"[iii] and this in two senses. First, the thing is understood as a member of a species, and as such, it reproduces itself through the perpetuation of the species. Second, it is an individual, and reproduces itself through the incorporation of raw matter into its structure, and through its self preservation. Furthermore, in order to be considered as a purposive unity, there are certain requirements on the structure of the thing in question. First, Kant argues that if something is to be considered purposive, the parts must depend on the relation to the whole, since it is this whole which defines their relations to one another. Second, the whole must be determined by the reciprocal relations of the parts. Thus, Kant writes that "just as each part exists only *as a result* of all the rest, so we think of each part as existing *for the sake* of the others and of the whole, i.e. as an instrument (organ)."[iv]

Moving from philosophy to anatomy, the key anatomist of the Aristotelian/Kantian tradition was a 19th century French anatomist known as Georges Cuvier. Cuvier attempted to provide a rational taxonomical model by developing his hypothesis of the conditions of existence, and the anatomical principle which follows from them, the correlation of parts.[v] The hypothesis of the conditions of existence states that there are certain general laws which are prior to the actual existence of the organism which govern its structure. The conditions of existence define a harmony in the functioning of the organism as a whole, which leads to the hypothesis that the nature and distribution of the parts of the organism can be discovered simply by reasoning from their place in the functional unity of the organism. It is this principle which Hegel cites with approval in the *Philosophy of Nature*:

> Every organised creature forms a whole, a *unified* and closed system, all the parts of which mutually correspond, and by reciprocal action upon one another contribute to the same purposive activity. None of these parts can alter without the others altering too; and consequently each of them, taken on its own, suggests and gives all the others. (*PN*, § 370, Add.)

Deleuze, Geoffroy, and Transcendental Anatomy

Having seen how the organism is structured in Cuvier's account, I now want to turn to Deleuze's own account of the organism. In order to do so, we will use Deleuze's commentary on the account of Geoffroy Saint Hilaire, a contemporary of Cuvier's. Geoffroy rejected Cuvier's approach, instead arguing for what he called a 'transcendental' or 'philosophical' anatomy. Rather than arguing

that comparisons between organisms should be grounded in an analysis of the form or function of their parts, Geoffroy instead proposed that anatomical classification should proceed along morphological lines. In rejecting form and function, Geoffroy argued that what was key was the relations between parts themselves. Parts were therefore understood in terms of their connections with other parts, and their genesis, according to an abstract schema. Such an account presented a radical break with a purposive, or teleological, account.

We can begin to understand Geoffroy's approach by looking at some of the differences between his analysis of organisms and that of the comparative anatomist. For the comparative anatomist, the names of the parts of animals are, to a certain extent, derived analogically with other animals, archetypally with man.[vi] Thus, for instance, we can apply the term 'legs' to other animals as they share certain characteristics of form and function with human legs. When the function or form of parts differ from those of man, however, a different term must be assigned to the part in question. Thus, although there is a similarity between the fins of a fish and the arm of man, on a teleological account, the functional and structural differences mean that different terms must be applied to each. Geoffroy's approach was to argue that parts in different animals may play different functional roles, but may nevertheless be classified as essentially the same. Thus, we may have an intuition that fins and arms, although fulfilling different functions, could be classified together because of their relation to other parts of the organism. These similarities across different organisms came to be known after Geoffroy as homologies.[vii] If homologies are to be understood on more than a simply intuitive level, however, it becomes clear that we need to discard, or at least supplement, the teleological understanding of the organism with another form of understanding which will give a rational ground for these similarities which cross functional boundaries. The principle which Geoffroy employs for this role is the principle of the unity of composition. In order to posit similarities, Geoffroy posited an underlying abstract structure for particular animal forms. This structure was not to be understood in teleological terms, the function of the structure emerging depending on the particular form this structure took in the animal in question. The underlying plan allows the homology to be defined without reference to teleology. The British comparative anatomist Richard Owen was later to define it as "the same organ in different animals under every variety of form and function", whereas Cuvier's analogies were defined as "a part or organ in one animal which has the same function as another part or organ in another animal."[viii] Thus, to use Appel's example, the legs of a crab are analogous to those of a quadruped, as they share the same function, but they are not homologous to them. Fins and arms, on the contrary, would be homologous without being analogous.

The classic example of Geoffroy's method was his application of the principle to the skeletal structure of the fish. Whereas under the teleological account, the specific nature of the various structures of different organisms are not of particular importance, since we are there concerned with identity of function, Geoffroy's account requires that the same connections of parts are expressed in different organisms. Whereas for a teleological reading, for instance, it does not matter precisely how many bones make up the skull, provided the function and form are similar in the two cases, on a morphological account such as Geoffroy's, it is essential that he is able to show how each bone is connected to each other. In order to show that both man and fish, both of which are vertebrates, are constructed according to the same plan, each bone within the structure of the fish must have a correlate within the structure of the mammal. Geoffroy actually attempted to prove this fact. He showed that, despite the fact that fish had a greater number of bones than mammals, by looking at the embryos of the two classes of vertebrates, equivalences could be found. Despite the differences in the final number of bones, the same number of centres of ossification were found in both types of embryos, although these fused together as mammalian embryos developed.[ix]

The central disagreements between Cuvier and Geoffroy were over the continuity of species, and the question of method. If species were to be understood in teleological terms, the notion of

intermediaries between species became nonsensical, since the organism is to be understood as a functional totality, a minor change in the structure of one organ would necessarily lead to reciprocal changes in the remainder of the organism. Cuvier took this to be the key argument against the possibility of the transformation of species, as changes would have to cut across the dead zone of teleological imperfection surrounding a given species. On Geoffroy's account, however, it *was* possible to see species as forming a continuity, since unity was defined by the connection of parts, rather than their particular instantiation in a teleological nexus. Cuvier argued that if homologies were to be understood as the identity of an organ across different species, we were led to absurdities, but if we rejected the idea that homologies were strict identities, then instead, we simply had a concept of analogy, such as that formulated by Aristotle, between different species. Following on from this criticism, Cuvier argued that many of the homologies proposed by Geoffroy were in fact mechanically impossible to perform on a given organism, such as the reversal of position of several key organs in fish compared to mammalian vertebrates.

Cuvier's criticisms in fact allow us to sharpen our notion of the homology, and to differentiate it from Hegel's notion of the archetype. In order to find responses to these criticisms, we need to recognise the transcendental moment at play in Geoffroy's work. Contrary to Cuvier's characterisation of homologies as involving direct relations between actual creatures, homologies instead refer to the transcendental unity of composition. It is because particular structures in different organisms are expression of this same transcendental unity of organisation that the homology exists between them. It is for this reason that Geoffroy resisted the characterisation of the unity of composition in terms of any particular structures of actual organisms, or in any particular function, and it is also for this reason that Deleuze finds resonances with his own philosophy in Geoffroy's work. Whilst Deleuze's claim that "Cuvier reflects a Euclidean space, whereas Geoffroy thinks topologically" (*ATP*, 47) may seem a little fanciful, Geoffroy's characterisation of the unity of composition purely in terms of connections does reflect a non-metric understanding of the composition of the organism, albeit not so developed as that which we saw in chapter four. Thus, Cuvier's criticism fails to his its mark, as Geoffroy's account does not deal with relations between actual terms, but between the transcendental and the empirical. The identities directly between actual organs which Cuvier attributes to Geoffroy simply do not occur, and hence neither do Cuvier's supposed absurdities. As Deleuze and Guattari write, "the important thing is the principle of simultaneous unity and variety of the stratum: isomorphism of forms but no correspondence; identity of elements or components but no identity of compound substances" (*ATP*, 46).

Teratology and Teleology

Deleuze, in his discussion of the debate between Cuvier and Geoffroy claims that "Geoffroy called forth Monsters, [while] Cuvier laid out all fossils in order" (*ATP*, 46). Whilst this is not an accurate literal portrayal of the debate, it does present well the difference between the two positions. As we saw, Cuvier claimed to be able to show the structure of the entire animal from a small set of bones, and used this technique successfully to prove the prior existence of now extinct species. The approach also led to gaps between species, where the combinations of different parts were not able to form a harmonious, purposive organism. Cuvier's teleological approach did not lead to him rejecting variation in the organism, but it was limited. In particular, variation became more common as one departed from the major organs, and considered those of less importance to the organism as a whole.[x] Deviations in minor organs were less likely to affect the optimal functioning of the organism as a whole, and could therefore be sustained. Prior to Geoffroy, little progress had been made in understanding difference in organisms beyond recognising "monsters by excess" and "monsters by defect."[xi] By providing a positive account of deformity in terms of the arrest of the development of a part of the organism leading to the actualisation of the unity of composition in a different form, Geoffroy was able to explain contingency in terms other than merely as an absence

of organisation. Thus, he attempted to show that aberrations still followed the principle of the unity of composition: "Monstrosity exists, but not, however, exceptions to the ordinary laws [of nature]."[xii] Furthermore, as the form of the organism was not understood in purposive terms, Geoffroy was able to give a positive description of these changes that allowed the organ either to no longer function in the new organism, or to change its function. Thus, whilst we might argue teleologically that the bones in the human skull are separate in infants and later fuse together by claiming that this aids parturition, a teleological account seems implausible of the separation of the same bones in birds, which peck their way out of a shell.[xiii]

Both of these notions, a positive understanding of contingency, and a theory capable of supporting identities irrespective of function are key to the theory of evolution, as they allow us to give a positive account of the structure of variation. This variation will eventually lead to speciation. Somewhat unsurprisingly, Geoffroy eventually developed from his own theory an account of the evolution of species, whereas Cuvier rejected any possibility of transformism of species on the basis that such a possibility would contradict the teleological account of the organism. Whilst Geoffroy's account of evolution was incorrect, as it was based on purely environmental factors affecting the developing embryo, what is key is that in moving to a non-teleological account of the organism, an evolutionary account of the organism became possible. Turning to Darwinian evolution, we can see that the main modification is the replacement, or perhaps grounding, of the unity of composition in an evolutionary account of the organism. For Darwin, therefore, homologies exist because organisms from different species share a common ancestor. The theory of homologies thus plays a central role in the formulation of his own account of the organism:

> Geoffroy St. Hilaire has strongly insisted on the high importance of relative position or connexion in homologous parts; they may differ to almost any extent in form and size, yet remain connected together in the same invariable order…what can be more different than the immensely long spiral proboscis of a sphinx-moth, the curious folded one of a bee or bug, and the great jaws of a beetle? – yet all these organs, serving for such widely different purposes, are formed by infinitely many modifications of an upper lip, mandibles, and two pairs of maxillae…Nothing can be more hopeless than to attempt to explain this similarity of pattern in members of the same class, by utility or by the doctrine of final causes.[xiv]

How is the unity of composition is incorporated into the Deleuzian system? Deleuze looks at a later work of Geoffroy's where he "spells out his dream which, he says, was also that of the young Napoleon: to be the Newton of the infinitely small, to discover 'the world of details' or 'very short distance' ideal connections beneath the cruder play of sensible and conceptual differences and resemblances" (*DR*, 185). He argues that what Geoffroy is aiming at with his emphasis on connections is a field of differential elements (the ideal correlates of the bones) forming specific types of relations (the connections which are central to Geoffroy's account). On this basis, Deleuze claims that the unity of composition functions like a Deleuzian Idea, attempting to fulfil his three criteria (*DR*, 184). The elements of the Idea "must have neither sensible form nor conceptual signification," and the unity of composition seems to fulfil this requirement due to the fact that it is essentially non-metric and topological, therefore differing from the actual structures which express it. Second, "these elements must be determined reciprocally," which in the case of the unity of composition, Deleuze takes to mean that what is central is not the bones themselves, but the connections they hold with other bones. Third, "a multiple ideal connection, a differential *relation*, must be actualised in diverse spatio-temporal *relationships*, at the same time as its *elements* are actually incarnated in a variety of *terms* and forms." In both *Difference and Repetition* and *A Thousand Plateaus*, Deleuze emphasises that the unity of composition implies that homologies do not exist directly between actual terms, "but are understood as the actualisation of an essence, in accordance with reasons and at speeds determined by the environment, with accelerations and interruptions" (*DR*, 184). That is, we note a homology by recognising that the actual parts of both

organisms are actualisations of the same transcendental essence, the unity of composition, rather than by a direct correlation of actual terms, as in Cuvier's comparative anatomy. The unity of composition therefore functions, according to Deleuze, much like the virtual, as that which is actualised, whilst differing in kind from its actualisation. Further, we can see that the concept of essence which Deleuze attributes to Geoffroy is seen by Deleuze as in no way similar to the classical conception, but functions more like a field of accidents, with no privileged form or level of organisation. Describing the Idea elsewhere in *Difference and Repetition*, Deleuze writes, "this, however, is precisely what is at issue: whether the notions of importance and non-importance are not precisely notions which concern events and accidents, and are much more 'important' within accidents than the crude opposition between essence and accident itself" (*DR*, 189). While Deluze believes that Geoffroy's position is advance over Cuvier's he does hold some reservations. He questions whether "anatomical elements, principally bones [are] capable of fulfilling this role [of providing a field of differential relations]" (*DR*, 185). He suggests that it is possible that these elements may still enjoy "an actual, or too actual, existence," implying that Geoffroy's anatomical elements may not be able to support the difference between virtuality and actuality required by the Idea: "there are perhaps as many differences between genetics and Geoffroy as between modern atomism and Epicurus" (*DR*, 185).

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[i] Kant, *Critique of Judgment*, §179.
[ii] Kant, *Critique of Judgment*, §180.
[iii] Kant, *Critique of Judgment*, §370.
[iv] Kant, *Critique of Judgment*, §373.
[v] Coleman, *Georges Cuvier Zoologist*, 40.
[vi] It is worth noting although man was often take as the archetypal organism in comparisons, this was not, as in Hegel's case, because man was the most perfect organism, but rather because man was the organism for whom the most complete anatomical accounts had been given.
[vii] Geoffroy in fact refers to them as analogues, a term now used to refer to similarities as characterised by a teleological account. Here I follow Appel, *The Cuvier-Geoffroy Debate*, in following the modern acceptations of the two terms.
[viii] Appel, *The Cuvier-Geoffroy Debate*, 71.
[ix] Appel, *The Cuvier-Geoffroy Debate*, 98.
[x] Coleman, *Georges Cuvier Zoologist*, 143.
[xi] Appel, *The Cuvier-Geoffroy Debate*, 126.
[xii] Appel, *The Cuvier-Geoffroy Debate*, 126.
[xiii] Appel, *The Cuvier-Geoffroy Debate*, 227.
[xiv] Darwin, *The Origin of Species*, 414.