Towards a Common Morphology For Aesthetics and Natural Science

A Study of Goethe's Empiricism

Ronald Harold Brady

Ph.D. Thesis
State University of New York at Buffalo

The main text has been produced by
University Microfilms, A XEROX Company, Ann Arbor, Michigan

73-5084

BRADY, Ronald Harold, 1937-
TOWARDS A COMMON MORPHOLOGY FOR AESTHETICS AND NATURAL SCIENCE: A STUDY OF GOETHE'S EMPIRICISM.

State University of New York at Buffalo,
Ph.D., 1972
Philosophy

University Microfilms, A XEROX Company, Ann Arbor, Michigan

TOWARDS A COMMON MORPHOLOGY FOR AESTHETICS AND NATURAL SCIENCE: A STUDY OF GOETHE'S EMPIRICISM

by

Ronald Harold Brady

A dissertation submitted to the
Faculty of the Graduate School of State
University of New York at Buffalo in partial
fulfillment of the requirements for the degree of
Doctor of Philosophy

September, 1972

CONTENTS

Introduction

After Kant had spoken, according to Hegel, the first rational word on Aesthetics, his work was recast in that of Schiller, and from this accomplishment there arose a major impetus toward the development of later Idealist Aesthetics. Schelling began his work under the influence of Schiller, and Hegel, also looking back to Schiller, continued from Schelling. All three men had the same central concern: to rescue Aesthetics from the subjective position assigned to it by Kant. It is therefore quite tempting to see their succession as continuous, the development of a single line of thought. Hegel himself suggested this in his *Aesthetic*, and the histories of Aesthetics have followed his lead. But this impression is misleading.

Schiller does not lead to Idealist Aesthetics so directly as the above impression would suggest. His departure from Kant does not immediately transit to such a position, but actually leads in another direction. At the time of his departure, Schiller came into a close friendship with Goethe, and together they worked out an aesthetics which stood in opposition to the position taken by Schelling and Hegel.

The nature of this position is not to be found in the histories, nor in the comments of later philosophers. Indeed, the whole thing seems to have slipped out of history altogether, and matters advance today as if it never was. That a philosophic position might be obscured with time is to be expected, but that it should be lost so utterly that none should ever guess its existence is surely catastrophic. This is yet predictable, however, upon the reflection that should a position be wrongly identified its actual content may be lost. So it happened in this case.

The reasons for the misidentification are not difficult to determine. Kant gave Aesthetic theory, which he practically invented for German philosophy, a decidedly speculative cast. Schiller originally followed in Kant's footsteps, breaking away only slowly. Being a practicing poet, his own concern was with matters of personal experience, and he was continually led to make empiric claims which he would then find in conflict with Kantian theory. Having no scientific method that could verify his claims, he was unable to progress. It was at this point that he met Goethe, and his position underwent a transformation as a result.

Goethe was a born poet and a born empiricist, and along with his studies of art he had studied nature. When Schiller had his first conversation with him, Goethe had already written his major contribution to Botany, and was working upon zoological treatises. They did not speak of art in their first conversations, but of science.

Schiller was evidently able to recognize that Goethe had claimed to progress beyond the limits set by Kant in his Critiques in just that manner that Schiller himself found attractive. He was not at all convinced, however, that Goethe's work was valid. The argument was carried forth on scientific grounds, most discussion centering upon the method of Goethe's scientific works (in Botany, Zoology, and Optics). Their letters, in this early period, provide a veritable mine of reflections upon scientific method, and the implications of differing methods. They undertake, and work through, a mediation between the two polar positions of their day, which Schiller calls 'Rationalism' and 'Empiricism.' The resultant position, termed by Schiller 'Rational Empiricism,' is then applied not only to problems of scientific method but to Aesthetic problems as well, and its implied epistemology is generalized.

But Schiller did not then write this down, but returned to poetry, convinced that he was then justified in doing so. The position is visible in the Aesthetic Letters, but that text is transitional and therefore its empiricist epistemology is only there for those with eyes to see it (through familiarity, for example, with the correspondence between Schiller and Goethe during this period). Goethe does make the approach available, but only in the form of treatises within the natural sciences. He writes no systematic Aesthetics; his remarks on the subject, without the context of his empiricism, are easily and usually misread. Of course, a large number of writers have since found Goethe a very interesting figure, both for science and Aesthetics, but only a few have troubled to ask where his many insights are actually coming from. (I was very fortunate to come upon two such men, and had I not read Rudolf Steiner and Ernst Cassirer on Goethe's epistemological position some years ago, I would never have realized that his work possessed something I very much desired.)

A crucial question for Aesthetics must be the nature of aesthetic appearances, but very little penetration into the structure of these appearances is usually effected, even by art critics, much less philosophers. (The work of Rudolf Arnheim may be an exception here.) In order to effect such a penetration, we need a study of form as experienced, of appearances as seen or heard; in short, a _morphology_ capable of discovering the coherent structure within appearances _qua_ appearances. It was just such a method that Goethe developed, and for it coined the name _Morphology_. This is his empirical base. Much of his critical terminology derives from it, and in general his approach to aesthetic structure seems to be governed by the considerations of his science.

Of course, a morphology of the structure of appearances is a crucial asset to any empiricism, and thus its possibility is a question that reaches beyond the confines of Aesthetics. The application of this science, if it proves to be a science, will range over a large area. In order to justify its use in Aesthetics, therefore, we must justify its use elsewhere as well. That is; before the worth of the method for Aesthetics can be shown, the method itself must be provided with an epistemological justification, But in doing this, in demonstrating the scientific status of morphological investigation, we provide a basis for applications other than those to be made within Aesthetics.

The purpose of this discussion therefore, will be the recovery of the empirical base of the joint position of Schiller and Goethe, and this entails an epistemological justification of that base. I shall introduce the investigation historically, beginning with Kant and Schiller and then studying the latter's development away from Kant under the influence of Goethe. I shall then seek, in the works of Goethe, the evidence upon which Schiller thought to ground his new position. This evidence may be found only in Goethe's scientific works. The discussion will, therefore, argue out the validity of morphology upon the same ground that it was originally contested by Schiller, that of natural science. Once the method is recovered, submitted to epistemological examination, and thereby shown to be a science, I shall return to Aesthetics proper in order to review Goethe's Aesthetics and suggest future tasks.

PART I

I Kant

Kant qualifies aesthetic pleasure in two ways that have a direct bearing on the structure of aesthetic appearances. He tells us first that such pleasure is taken only in the <u>form</u> of what is portrayed rather than the subject-matter (taking the plastic arts as a paradigm case for our discussion). It is a "disinterested" pleasure as regards the possible existence or non-existence of the object. We gain a certain pleasure, that is, in the mere contemplation of an image—the Mona Lisa for example—while the identity of the model, or even whether any such model actually existed, is of no immediate concern. We may, of course, take a lively interest in such matters, and the answers we uncover may profoundly affect our viewing of the picture (Leonardo's context, once clarified, may alter our mental perspective), but Kant's claim is only that, once a particular perspective is gained, our aesthetic pleasure in the appearances so viewed will depend upon their <u>form</u> alone.

In aesthetic contemplation we may, according to this argument, enjoy a structure of appearances simply as form. When we say that a portrait is beautiful, we do so whether or not it is a portrait <u>of someone</u>, or even, in the case of a modern non-representational canvas, whether or not the picture is <u>of some thing</u>. That pleasure that Kant terms aesthetic is free of these concerns.

Kant's second qualification is that aesthetic appearances please without a <u>concept</u> of the form presented. The pleasure is made possible by the arrangement of the perceptual elements of the image, which must seem highly organized, even planned, and is therefore seemingly <u>purposive</u> (ordered to some end), but no "rule" governing this order may be discovered. If we were able to find such a conceptual rule, some formula or law which governed the form and assembled its elements in the manner that the concepts of natural science govern the phenomena they explain, Kant insists that no aesthetic pleasure would be possible.

This notion of 'purposiveness without a purpose,' a seemingly end-oriented arrangement in which no actual end or conceptual design may be discovered, is not as paradoxical as it may first seem. The idea of a poetic <u>diction</u>, a particular arrangement of linguistic elements which causes those elements to carry a greater import for the mind than would normally be possible in prosaic usage, is commonly recognized by literary critics. But no conceptual rule may be given for such a diction. We cannot, that is, learn how to write good poetry by formula, nor analyse such poetry into formulas. A similar situation holds good for all the arts. In each, it is possible to speak of the additional import given the perceptual elements by the particular arrangement made of them by the artist, the addition made to appearances by artistic treatment, but we are not able to reduce this additional import to a concept, a rule by which the elements can be discovered to be ordered.

If we return for a moment to the example of poetry, we may see why Kant claims that such reduction would destroy the aesthetic pleasure. Poetic speech is not paraphrasable. That is, the particular import added by the diction may not be paraphrased in prose. It is, in fact, the very thing that differentiates poetry from prose, and could it be reduced to prose content there would be no difference between poetry and prose. To find a conceptual rule for the diction however, would allow one to state the meaning of the diction in concepts, which are of course paraphraseable, and thereby reduce the poetic passage to prose paraphrase, effectively canceling the distinction between prose and poetry. At this point the poetic passage would turn into expository prose, and the aesthetic effect that we expect to gain from poetry would not be possible.

Kant adds that natural beauty, or the beautiful in nature, pleases when it resembles art (has a diction), and art pleases when it resembles nature (is not reducible to conceptual planning). Genius, says Kant, is the faculty through which nature gives the rule to art, that is, determines the diction of art (but without a conceptual rule), and thus we find nature underlying art. The organic realm is for Kant nature par excellence, and as we shall see later, he implies that artistic diction and organic order are related.

Our 'disinterestedness' in the object of aesthetic appreciation can be reflected in an existential qualification of the object itself. For instance, Kant says that poetry "plays with illusion [Schein - semblence or appearance], which it produces at pleasure but without deceiving by it; for it declares its existence to be mere play,"[1] thus introducing two notions that Schiller will expand in the Asthetische Briefe (semblance and play). The first concept, Schein, is an appearance which is taken as such, and cannot therefore bring a deception with it. The participation in the poetic illusion is self-consciously willed (at least by a cultured adult). We know that we are attempting to 'make it work' when we read a poem, and recognize as well that some effort is necessary to make a good reading, even when reading silently to ourselves. (So Coleridge spoke of the "willing suspension of disbelief that constitutes poetic faith"[2] in the Biographia Literaria, pointing out that such participation is our act, and one that is performed knowingly.)

The required attitude is a familiar one. We do not, for example, follow a Shakespearian tragedy as we would follow actual events. We enjoy it in a manner that would be quite impossible were we to confuse it with reality. There is nothing particularly delightful, at least in Kant's sense of delight, about watching a bloodbath; but as a play, Hamlet pleases us with the inevitability with which the tragedy claims its victims. We worry about Hamlet, but we do not, if we appreciate the necessity of its structure, want the ending of the play to be altered. Hamlet's death, if we look at this in Kant's aesthetic manner, is necessary for his identity is not his personal presence but his whole story. If he does not die, he is not Hamlet. In this sense, the play is never treated as reality, but only as a 'show,' an appearance which we can enjoy because it is <u>not</u> real.

Our inability to define the aesthetic order with a definite concept is also a familiar experience, as I have already mentioned in the discussion of the notion of <u>diction</u>. To this we might add, as Kant does, that we cannot identify beauty in form according to logical attributes, cannot, therefore, write rules for either judging or creating art works. This seems obvious if by 'rules' we take our notion from the physical sciences. We cannot seem to specify a list of attributes to be met if beauty is to be judged or achieved; the matter is much more uncertain than that.

More striking perhaps, is the concurrent inability to put our finger upon just what it is that intrigues us in some works. There is something elusive about a poetic diction, for example, that escapes all attempts to 'see' the particular element that moves us. We repeat the words again in the mind, turn them over, sometimes the effect weakens, sometimes it returns again in strength. Certainly the concepts present do not change while we do this, but something does. And the most puzzling aspect is that we feel, when the 'effect' strengthens, that we are in some sense 'seeing' something. Beauty traditionally makes one look more closely, arouses an intensified attention, but the focus of this attention is never conceptually found.

Because Kant has done such a good job at presenting 'the way it may seem,' I shall present the long section of Kantian 'literary criticism' found in paragraph 49 of the Critique of Judgment, which is, in my opinion, a very important description. That section, together with the theoretical introduction and following commentary reads as follows:

> If now we place under a concept a representation of the imagination belonging to its presentation, but which occasions in itself more thought than can ever be comprehended in a definite concept and which consequently aesthetically enlarges the concept itself in an unbounded fashion, the imagination is here creative, and it brings the faculty of intellectual ideas (the reason) into movement; i.e., by a representation more thought (which indeed belongs to the concept of the object) is occasioned than can in it be grasped or made clear.
>
> Those forms which do not constitute the presentation of a given concept itself but only, as approximate representations of the imagination, express the consequences bound up with it and its relationship to other concepts are called (aesthetical) attributes of an object whose concept as a rational idea cannot be adequately represented. Thus Jupiter's eagle with lightning in its claws is an attribute of the mighty king of heaven, as the peacock is of its magnificent queen. They do not, like logical attributes, represent what lies in our concepts of the sublimity and majesty of creation, but something different, which

gives occasion to the imagination to spread itself over a number of kindred representations that arouse more thought than can be expressed in a concept determined by words. They furnish an aesthetical idea, which for that rational idea takes the place of a logical representation; and thus, as their proper office, they enliven the mind by opening out to it the prospect of an illimitable field of kindred representations. But beautiful art does this not only in the case of painting or sculpture (in which the term "attribute" is commonly employed); poetry and rhetoric also get the spirit that animates their works simply from the aesthetical attributes of the object, which accompany the logical and stimulate the imagination, so that it thinks more by their aid, although in an undeveloped way, than could ever be comprehended in a concept and therefore in a definite form of words. For the sake of brevity, I must limit myself to a few examples only.

When the great King in one of his poems expresses himself as follows:

Oui, finissons sans trouble et mourons sans regrets,
En laissant l'universe comble de nos bienfaits.
Ainsi l'astre du jour au bout de sa carriere,
Repand sur l'horizon une douce lumiere;
Et les derniers rayons qu'il darde dans les airs,
Sont les derniers soupirs qu'il donne a l'universe;

he quickens his rational idea of a cosmopolitian disposition at the end of life by an attribute which the imagination (in remembering all the pleasures of a beautiful summer day that are recalled at its close by a serene evening) associates with that representation, and which excites a number of sensations and secondary representations for which no expression is found. On the other hand, an intellectual concept may serve conversely as an attribute for a representation of sense, and so can quicken the latter by means of the idea of the supersensible, but only by the aesthetical element, that subjectively attaches to the concept of the latter, being here employed. Thus for example, a certain poet says, in his description of a beautiful morning:

The sun arose
As calm from virtue springs.

The consciousness of virtue, if we substitute it in our thoughts for a virtuous man, diffuses in the

> mind a multitude of sublime and restful feelings, and a boundless prospect of a joyful future, to which no expression that is measured by a definite concept completely attains.
>
> In a word, the aesthetical idea is a representation of the imagination associated with a given concept, which is bound up with such a multiplicity of partial representations in its free employment that for it no expression marking a definite concept can be found; and such a representation, therefore, adds to a concept much ineffable thought, the feeling of which quickens the cognitive faculties, and with language, which is the mere letter, binds up the spirit also.[3]

Speaking of the nature of genius, Kant adds:

> to express the ineffable element in a state of mind implied by a certain representation and to make it universally communicable...this requires a faculty of seizing the quickly passing play of imagination and of unifying it in a concept (which is even on that account original and discloses a new rule that could not have been inferred from any preceding principles or examples) that can be communicated without any constraint of rules.[4]

The profusion of lines of thought suggested by the aesthetic effect, the mysterious sense of a type of cognition which escapes our comprehension (ineffable thought), the heightened activity of awareness (quickening of cognitive faculties), and the sense that the poem has somehow caught an elusive glimpse of the "quickly passing play of imagination", all these experiences are well known to the lover of poetry. Whether or not we accept Kant's explanation of them, we at least recognize them. The key term is "ineffable", and I would think that any perusal of the critical literature of this century or the last would testify to the staying power of the tendency to present this sentiment in one form or another.

According to Kant's theory, the particular "ineffable" that we have here is the "aesthetical idea," which seems, in immediate reflection, to be highly ordered (unified) but for which no concept can be found. In each of the three cases mentioned, the poetic representation presents more attributes than any concept could determine. The mind senses that all these attributes, or "partial representations," proceed from a common unity, but is unable to find this unity (unless it is the unity of the sensible manifold which is the aesthetic representation). But why should this inability arise? Why should we have to speak of <u>ineffable thought</u>? Given that the situation does actually often <u>feel</u> that way, is it not a mystification to speak of thought, which is, one would think, at least intelligible if it is thought at all, as ineffable?

We can discover a good deal more about such things by investigating the second half of the third <u>Critique</u>. Kant's investigation of teleological judgment provides a commentary upon a situation which seems to be at least a parallel case, if the relation is not a closer one. Let us examine Kant's discussion of organic life.

We have the concept <u>life</u>, and must utilize it in order to deal with everyday experience, yet it is not, says Kant, a scientific concept, but rather a speculative Idea put forward by pure reason, and undetermined by phenomenal evidence. This situation is the result of our inability to grasp the internal relations of an organism according to those conceptual principles (of natural science) which may be found analytically in phenomena. Living things are highly ordered, or at least give the impression of being so, but when we seek for an ordering principle we do not find it in the sensible manifold. The living body does not show us its ordering principle, and we find that a simple addition of the parts into a mechanical whole does not explain the notion of the whole which we have to begin with. The term "organic" is meant to distinguish a whole from that produced by mechanical summation. The experiential object, the organism, seems, to human reflection, quite other than mechanical. But when we seek for the ordering principle which could explain this, we find nothing more than mechanical relations (in the phenomenon itself).

Since we <u>represent</u> the organism <u>as</u> organic (look at it in such a manner that it seems 'organic'), that is, as if its unity were more that the sum of its parts, as if, in fact, the parts were somehow derived from the whole rather than vice-versa, we must find some means of <u>thinking</u> the organism which meets this mode of representation. We solve this by the introduction of teleology. We say the organism seems 'planned' or 'designed' for a specific purpose, in this case, let us say self-perpetuation. We may imagine an intelligent creator so constructing them, or even simply treat them as <u>purposeful</u> in this sense without determining the principle by which they are ordered. The point is, we have 'saved appearances' and found a way of thinking that recognizes the 'organic' aspect of our representation in conceptual terms.

But due to this teleological mode, <u>life</u> has become a principle which is purely speculative. It is not found in the phenomenon by analysing the composition of its parts (an adding them together again). It cannot be merely the sum of parts, but is rather the origin of those parts, some inner principle which causes growth and motion to take place as they do. Since scientific knowledge would consist in the actual analysis of the phenomenal evidence according to the principles of natural science (which are mechanical), no such knowledge is here forthcoming. The teleological mode of thought removes the determining principle from the phenomenal field and assigns it either to an unseen creator, an unknown guiding principle, or an unmanifest (except in its effects) inner essense. It may have a <u>regulative</u> function for scientific investigation, that is, may guide the investigator as he discovers the nature of those mechanical processes by which the organism maintains itself, but it can never be <u>constituitive</u>, i.e. a principle which is analytically found in the phenomenal evidence itself. (Since teleology removes the determining cause from the phenomenal field, no teleological principle could, by definition, be found by analysis of the phenomenon.)

The result above does not mean that organisms are without any naturalistic determining principles, or without any external evidence of this, but only that we cannot discover them. Only our own limits are here demonstrated. We may imagine another mode of comprehension which would not need any recourse to speculative teleology, but could grasp, by its experience of the whole, the unifying principle. An intuitive understanding, for example, might be able to perform in this manner:

> We can, however, think of an understanding which being, not like ours, discursive, but intuitive, proceeds from the synthetical-universal (the intuition of the whole as such) to the particular, i.e. from the whole to its parts...
> It is here not at all requisite to prove that such an intellectus archetypus is possible, but only that we are led to the idea of it - which too contains no contradiction - in contrast to our own discursive understanding, which has need of images (intellectus ectypus) and to the contingency of its [image-requiring] constitution.[5]

The possibility of moving from the whole to the parts is the key to the organism, for this would reveal the manner in which its non-mechanical unity is constituted, and would enable the mind to find this unifying principle in the "intuition of the whole as such", the intuitive manifold. An intuitive understanding, which creates its own manifold by thinking it (by intuiting the whole - see the discussion of such an understanding in the first Critique), could think a synthetic-universal, but we cannot, for our intellect requires that it be given images which it then analyses into its discursive concepts and rebuilds.

The relation of the organism to the "aesthetical idea" should now be apparent. Both are represented in immediate reflection as unified by a single principle, but in neither case may this principle be discovered. It is, of course, the form of the sensible or intuitive manifold which causes the mode of representation in the case of the aesthetic experience, and although the representation of the organism includes more than this (the interdependence of the parts for their material existence is also specified), here too the <u>form</u> reflects the same problem (things which are organic <u>look</u> organic as well, and we recognize them by their visible aspects long before we are sure of the causal relations). We may see too, that in either case, the ultimate question is one of causality, i.e. the discovery of the determining principle, whether of the formal or material relations (in the case of <u>life</u>, we assume that this is one principle), and that, according to Kant's analysis, this principle, if it were to be known scientifically, would have to be found in the phenomenal appearance (in the whole the representation of which has set us the problem in the first place).

Kant is actually a very astute observer, particularly of psychic elements in perception. His descriptions have indeed caught 'the way it seems' in common experience, whether he is speaking of aesthetic diction or organic order (which is also, it seems a diction, an arrangement which fits a certain mode of representation). Due to his ability to remind us of something we have experienced, even distantly, he commands a good deal of respect from the reader who may have no suggestion of his own. It is always a relief to have something mystifying explained in such a manner that it <u>seems</u> to have been cleared of mystery. Of course, this is illusory. Kant has not removed the "ineffable" element at all, but merely codified it by recognizing a limit.

Kant's method was, from the beginning, based upon the recognition of limits and the resultant picture of human understanding. In this particular case, the limit is the most important in the Kantian corpus, the lack of "intellectual intuitions," ideas which are both thought ahd perception at the same time. If such a capacity were available to the human mind, we could obviously know "thing-in-themselves" for the thing perceived would be, in its noumenal self, the idea thought. By denying intuitive thought, Kant postulates a system, but he pays a heavy price. He must split perception from conception, feeling from thought. He must restrict science to mechanics and mathematics, rejecting descriptive science as an impossibility. He must place the "ineffable" element of aesthetic perception, and indeed, organic life itself, forever beyond human grasp. We can hardly wonder that, no sooner were Kant's limits recognized, that later 'Kantians' began finding means of interpretation which allowed one to transgress beyond them.

As the reader has probably already noticed, one of the obvious arenas of transgression is science itself. Biology has by no means been limited to the Kantian mold. Morphology, for one development, is a purely descriptive science, and yet it is essential to all modern taxonomy, comparative anatomy, and descent theory. But Kant did not have Morphology before him when he wrote that there could only be as much science in an investigation as there was mathematics (first Critique). He was thinking, when he turned to biology, of Linnaeus, and the so called "artificial" methods of taxonomy. These were indeed unable to come to grips with the question of determining principles, facilitating logical handling by setting up a list of external characteristics which were chosen, not by some criterion inherent to organic life itself, but to those external marks easiest to utilize for purposes of identification. Had Kant seen the work of Cuvier and others, Ernst Cassirer concluded, he would not have been so adamant about his restriction of biological science to the discovery of mechanical processes utilized by the organism.[6] However the case may be, biology, at least, has not so restricted itself.

We may turn again now to aesthetics, and look for the same sort of movement there, away from Kant's limits and towards a synthesis that he denied any possibility. But this was not done in direct resistance to Kant's Critiques, but rather almost through a dialogue with them. It was only after this dialogue had produced the first freedom from Kant that a Hegel could attack Kant's work directly and fundamentally. In biology, for example, Cuvier, the first man to formulate a truly descriptive science, was stimulated by Kant's work as a student and thought of his own accomplishment as an extension, rather than rejection, of Kant's.[7] Schiller, who began the struggle for a post-Kantian aesthetics, finally broke with Kant, but began as "a trained Kantian," thinking, like Cuvier, to extend rather than refute. After all, Kant had described, had he not, the feel of the thing rather well, and it is difficult to see where description ends and speculation begins.

II Schiller

Speaking of Kant's work in the Asthetische Briefe, Schiller remarks that it is his belief that "only the philosophers" are at variance with Kant's ideas, the rest of mankind being agreed. The judgments of the second Critique in particular, he thinks, can be shown to be the "immemorial pronouncements of Common Reason" once they are divested of their technical form. Schiller continues:

> it is precisely this technical form, whereby truth is made manifest to the intellect, which veils it again from our feeling. For, alas! intellect must first destroy the object of Inner Sense if it would make it its own. Like the analytical chemist by analysing them, only lay bare the workings of spontaneous Nature by subjecting them to the torment of his own techniques. In order to lay hold of the fleeting phenomenon, he must first bind it

> in the fetters of rule, tear its fair body to pieces by reducing it to concepts, and preserve its living spirit in a sorry skeleton of words. Is it any wonder that natural feeling cannot find itself again in such an image, or that in the account of the analytical thinker truth should appear as a paradox?[1]

Such statements seem more like a vein of complaint than praise, and as we shall see, Schiller is not at all at home with Kant's conceptual technology. Poetry should bring form and content, structure and feeling, together, but technical philosophy, which alone seems to reveal truth, does the opposite. This suggests a fault in either poetry or philosophy, unless the apparent opposition can be mediated.

Schiller's venture into aesthetic theory was made upon Kantian foundations, but in the opinion of most later commentators, finally transcended them. The most famous estimation of this movement within Schiller's thought is probably Hegel's, and for that reason I present it here:

> it must be admitted that the art-sense of a profound mind - which was philosophic as well as artistic - demanded and proclaimed the principle of totality and reconciliation before the time at which it was recognized by technical philosophy. In so doing it opposed itself to (Kant's) abstract infinity of thought, his duty for duty's sake, and his formless 'understanding' which takes account of nature and reality, sense and feeling, only as a limit, as something absolutely hostile, and therefore antagonistic to itself. It is Schiller then to whom we must give credit for the great service of having broken through the Kantian subjectivity and abstraction of thought, and ventured upon going quite beyond it by intellectually apprehending the unity and reconciliation as the truth, and by making them real through the power of art.

> ...Now this unity of the universal and the particular, of freedom and necessity, of the spiritual and the natural, which Schiller scientifically apprehended as principle and essence of art, and unweariedly strove to call to life by art and aesthetic culture, was in the next place erected into the principle of knowledge and existence as itself the Idea, the Idea being recognized as the sole truth and reality. It was by this recognition that science attained in Schelling its absolute standpoint.[2]

While we need not search out the full import of this tribute in regard to idealistic philosophy, it will be useful to note that Hegel praises Schiller for a mediation of opposites which have been bequeathed him by the Kantian system, and sees, in the results of this mediation, the discovery of the Idea in his own sense of that term. This is an illuminating insight if one takes from it the suggestion that Schiller is not able to satisfy himself within the Kantian limitations of thinking, and will therefore attempt to extend them to a new principle. This is indeed his characteristic approach, although he is not immediately aware that he is not simply adding footnotes to Kant but actually breaking with him. It is, of course, his break with Kantian aesthetics that we are to examine in this paper, and so we may expect that the new principle in the offing will have something to do with the unification of structure and feeling, with overcoming the very opposition that Schiller seems reconciled to in his comments upon the technical form of philosophic thinking quoted above.

Kant had left aesthetics in a 'subjective' state, that is, he had defined it in terms of the condition of the viewing subject. This is manifestly unsatisfying in as much as it is the object before us, rather than our feelings about it, which we find beautiful. By explaining this beauty in terms of a harmony between the form of the object and the faculty of understanding, Kant had avoided any attempt to look into the nature of beautiful form, for its harmony with the understanding simply means that it is regarded with approval and pleasure, i.e. that we find it beautiful. It says little or nothing about the governing principle of such form, nor does it allow us to 'understand' it. No 'objective' description of the beautiful could arise from this approach.

In a letter written to his friend Körner late in December, 1792, Schiller declared:

> I think that I have discovered the objective idea of the Beautiful, which is qualified, eo ipso, to be the objective principle on which taste is founded, and which Kant tormented his brain about without success.[3]

He then proposed to write a dialogue upon the subject, to be entitled Kallias, or Ideas on the Beautiful, and reported, in his letters of the next two months, the progress of his thought. The project was not completed under this title, and the train of argument Schiller began here led eventually to the Aesthetic Letters, which broadened the theme considerably. The "objective idea of the Beautiful" is not discussed, however, in the later work, and only the so called "Kallias letters" (for so the letters to Körner on this subject have come to be named) survive as witness to Schiller's theory of aesthetic perception.

The opposition of structure and feeling mentioned above makes its first definite appearance in the Kallias letters through a criticism of Kant's distinction of "pure" and "dependent" beauty, and in particular his refusal to recognize any mediation between a discursive concept and an aesthetic percept:

> he [Kant] affirms, somewhat curiously, that every beauty which stands under a concept of an end is not a pure beauty; that consequently an arabesque of something similar, considered as beauty, is purer than the highest beauty of Man. I find that his observation may have the great advantage of separating the logical from the aesthetic, but it seems to miss the concept of the beautiful entirely. Beauty shows itself in its highest splendor where it overcomes the logical nature of its object, and how may it overcome when there is no resistance? How can it bestow its form upon completely formless material?[4]

Kant had termed the beauty of an arabesque "pure" because its form was not the form of something. Following his theory that beauty pleases without a concept, being but the harmony of the form before the mind with the faculty of understanding, he had concluded that, not only could beauty exist without a recognizable subject, but that the addition of such a subject could not improve the situation, adding nothing positive in an aesthetic sense. Indeed, he thought the logical subject (conceptual) would only detract from the desired harmony, since it provided another motivation for the mind beyond aesthetic contemplation, i.e. the consideration of ends. Such mixed beauty he termed "dependent", and spoke of it as if it were in some way weakened when compared to "pure" beauty. Since this would mean, however, that the beauty of a sculpture by, let us say, Praxiteles, would be in some way inferior to that of a minor but perfectly executed decoration, Schiller rebels.

Schiller's argument that beauty appears most powerfully when it overcomes the logical nature of its object adds an emphasis to the matter that Kant did not have. The third Critique did recognize the ability of beautiful form to draw the mind away from any consideration of ends into a "disinterested contemplation" of form alone, but nothing was said about the possibility that the overcoming of logical subject might contribute something to the aesthetic effect. Schiller has a very specific notion of the beautiful in mind however, and his question as to how the form of beauty may be added to the form of the subject reveals that he has attempted an 'objective' description — beauty is now a specific form. The passage continues:

> I at least am of the opinion that Beauty is only the form of a form and that which is called its material must definitely be a formed material. Completeness is the form of a material, and beauty, in contrast, the form of the completeness, which completeness stands in relation to beauty as a material to a form.[5]

For all the difficulties in terminology that these two sentences may produce, Schiller's point is quite clear: beauty is to the form of a material as the form of a material is to the material alone. It is thus called "the form of a form." From this we may infer that, had the material in question no specific form of its own, beauty could not be added to it, for only a formed substance may act as material to the form of beauty. The way is now open to a concept of beauty in which the logical nature of the object involved is a necessary prerequisite for its beauty (and very possibly determines the 'height' of manifestation of beauty), rather than a detraction.

Passing on, in the subsequent letters, to what he considers a properly critical approach, Schiller sets forth a number of categories of judgment (after Kant), the point of which is that, even as a teleological judgment is an analogue to a logical one (as is pointed out in the third Critique), so an aesthetic judgment is an analogue of a moral one. We judge freedom when we judge morally, but the semblance of freedom when we judge aesthetically. The form of beauty, then, is, in some sense, the semblance of freedom, and so we get the central notion of the Kallias letters: "Beauty is nothing else but freedom in appearance."[6]

Körner objects, at this point, to a priori proof. The speculative method that Schiller has been following seems to him 'subjective'; he evidently wants the thing pinned down to examples. Schiller begins again in a more detailed manner:

> Because only that Will which can determine itself according to bare form is called free, so in the sense-world that form which appears to be determined purely through itself is a presentation of freedom; an idea being presented when it is so bound up with an intuition [sensible] that both seem to share a single principle.
>
> Freedom in appearance is nothing else but the self-determination of a thing, insofar as it reveals itself in intuition. One sets it in opposition to every determination from without even as one sets every determination through material grounds in opposition to a moral action.[7]

But, Schiller continues, no objects in nature, and certainly none in art, are entirely self-determining. Thus, as we think about the matter, nowhere can we find such self determination in actuality. Art, however, does not deal with actualities.

> But everything alters when one puts aside the theoretical investigation and takes the object <u>as it appears</u>. A rule, an end, can never <u>appear</u> for they are concepts and not intuitions. The actual ground of the possibility of an object never falls, therefore, within the sensible, and is so good as to be absent entirely "as soon as the understanding is not motivated to seek for the same." [source of quote unknown][8]

Schiller is making an indirect or negative approach to the subject, arguing that if the understanding is not motivated to seek for a conceptual causal ground (or teleology) then the object will not seem determined. Whatever is not present for the mind at the moment of observation will not be present in the appearance it observes. Through the negative, then, we approach our goal:

> for that which is not determined from the outside is a negative representation for that which is determined through itself, and indeed the single possible representation of the same, for while one may think freedom, he may never know it, and moral-philosophy itself must make do with this negative representation. A form appears free therefore, when we neither find the ground thereof outside it nor are motivated to seek it outside.[9]

The actuality of freedom is supersensible and thus beyond human experience. As such, it cannot become an object of knowledge. We must be able to represent it to ourselves, however, since we cannot avoid thinking of it (second <u>Critique</u>), and we do so through the negative representation of something (human action, for example) which is not determined from the outside (from the man's environment or bodily constitution). Because we represent freedom in this manner, a form which does not appear determined from the outside, nor motivates us to seek such determination,appears free, meeting our representation of freedom.

As Schiller progresses however, he becomes dissatisfied with a purely negative approach. He begins to move in the opposite direction, and his next formulation adds that we must at least think about the possibility of an external determinant and reject it

> because a bare negation can only become noticed when the want of its positive alternatives is presumed.[10]

Once this firm rejection has taken place, it becomes an affirmation of the self-determining nature of the object, since, according to our a priori rule of causality (everything that is is caused), and object, qua object

> must present itself as determined and should therefore lead us towards the determining factor [11]

The understanding, it seems, is unable to ignore the causal category, being the "faculty which seeks the ground of a consequence",[12] and thus demands that cause be assigned in every case. When it cannot, due to the rejection above, find an external determinant, it must accept the only alternative, and assign an internal one.

Even this position is not, in the end, fully satisfying, and Schiller will move a little further toward a positive conception. He had, after all, set out to say something about the objective qualities of the beautiful, but since his first remarks he has spoken of the form of beauty only in terms of the subject's position regarding it. He now attempts to qualify this 'form' more directly:

> The object must possess and show such form as admits of a rule, for the understanding can conduct its activities only after rules. But it is not necessary that the understanding know this rule (for knowledge of the rule would destroy all semblance of freedom, as is actually the case with every strong regularity), it is enough that the understanding be actuated by a rule, however undetermined. One need only view a single tree-leaf and the impossibility that the diversity of these has been able to order itself by accident or without some rule presses upon him, even though he does not judge teleologically. The unmediated reflection on the appearance of the diversity proves this without any necessity that one understand the rule and form a concept of it.[13]

The point is that we can recognize a pattern without being able to say just what pattern it is. This is common experience, all the more recognizable in the form that Schiller has cast it -- the sense of a definite if unknown geometry governing the variations of tree-leaves. (Leaf patterns, by the way, can indeed be mathematically described, but this does not detract from Schiller's point that we recognize the presence of a pattern without the aid of such description.) But this familiar instance has actually led to a crisis.

Schiller has transited slowly from a purely negative position to a positive one. "Freedom in appearance" began as an appearance which neither seemed determined by an external ground nor led the observer to search for one. This gave way to an appearance which led the observer to search for a determining ground and caused him to reject the possibility of an external ground, thus choosing the alternative. Our last modification shows Schiller insisting that "Freedom in appearance" must be the result of a specific type of form in the object, this form being, evidently, the cause of our inclination to see it as determined from within rather than from without. We have come to the point at last, for if Schiller wants to argue that "Freedom in appearance" is the same as beauty, and would keep as well his earlier suggestion that beauty is the "form of a form," then he must show "Freedom in appearance" to be a type of form, and it is high time that he tell us what type. So he does, or at least tries to, but he is on precarious ground here, and is aware of his danger.

Schiller began with the notion that he would add an 'objective' side to Kant's aesthetics. He considers himself a Kantian, and thus he takes his modifications of Kant to be minor, his major contribution being an addition rather than a correction. (Hegel, as we have seen, thinks otherwise.) But Kant put serious restrictions upon the possible content of intelligible thought, and Schiller is beginning to chafe against the bit. It is immediately understandable that once we find an external determining cause for a particular condition of an object (the motion, let us say, of a billiard ball), we cannot see that object as self-determining. But there are two further types of 'external determinants' that are less obvious to the casual reader. One is hidden in the teleological judgment. For instance, if we assume, upon studying the human body, that the heart beats 'in order to circulate the blood,' we read into the simple fact of a beating heart and its consequence (circulation) the <u>purpose</u> that a creator might have had in mind when he 'made' the body. As long as any such intelligent ends are assumed for natural events, those events exist, to some degree, 'for the sake of' those ends, and are therefore determined by considerations that go far beyond the events themselves.

This is why Schiller is careful to exclude the teleological mode of judgment, and the corresponding representation, in the quote above. Kant had said that we must represent some things (like organic life) teleologically, but could not investigate the result of such a representation scientifically since the teleological notion put the determining ground beyond the sensible phenomena. We look upon a body as if it were planned, but are forced to place the originator of the plan beyond the phenomenal world (a devine intelligence perhaps) and thus beyond investigation. If "Freedom in appearance" were predicated of a form (appearance) which was produced through a teleological mode of representation, the title would contain a contradiction, for to appear planned by some non-phenomenal power is manifestly to appear unfree. But we may see tree-leaves as patterned according to law whether we judge teleologically or not. Their pattern cannot be, therefore, the result of a teleological representation.

The other less obvious 'external determinant' is, it would seem, simply a concept itself. Any and all human concepts, according to Kant, are analytic-universals. They name general characteristics or laws, and cannot determine the specific nature of anything, or to put it in a more definite manner, they treat their subject inorganically. Inorganic phenomena may be treated as if they were produced by combination of certain characteristics and conjunction of certain laws. We may find satisfaction when watching the collision of billiard balls, for example, by combining our concepts of inertia, reciprocal reaction, friction, elasticity, and so on under the broader categories of causality and the laws of logic, but we cannot feel the same way about a living body. Here we want some principle that determines the manner in which the analytic-universals are combined in the particular species we are examining. The conceptual definition of the dog family will include all those characteristics that have been found to be collected in the animals as empirically met. This allows us to identify and handle the species logically, but it does not provide the causal determinant which makes a dog this sort of animal and no other. When we look at the animal, we take it for granted that some organizing principle has governed its formation, and we feel supported in our judgment by the fact that the dog passes the same characteristics on to its offspring, and they to theirs, but we do not find (in terms of eighteenth century science) this principle. Thus our reason for resorting to teleological judgment. Only what Kant calls a <u>synthetic-universal</u> could supply the needed unifying principle, but these are beyond the human mind.

If all concepts are <u>analytic-universals</u>, then none are capable of providing an organizing principle for a particular object or even species of objects, since they simply record the collection of characteristics by which such an object or species is identified, rather than the determinant by which those characteristics are brought into one unity. For this reason, they are in a certain sense external to any particular object, handling it 'from the outside' rather than revealing its organizing essence. And, of course, as Schiller points out in the quote at the top of page 28, the concept, inasmuch as it is a concept and not an intuition, "<u>can never appear</u>," cannot be phenomenal in the object. Again, only a <u>synthetic-universal</u> could do this, for such a concept would be intuitive, producing its own intuition and therefore 'appearing.' For these reasons, "...every concept is something external, over against the object";[14] and to identify the 'rule' of a form conceptually would be to destroy any appearance of freedom. To find, for instance, that our tree-leaves are variations on a logarithmic spiral, and to identify that mathematical concept with the pattern we see, would be to find an external determinant behind the form, logarithmic spirals being a law general to many phenomena and not particular to plant life.

On the other hand, if the form in question cannot be identified with a definite concept, it must still <u>seem</u> as if it were governed by a positive rule — the understanding must grasp it with a certain clarity, as we recognize pattern in tree-leaves without any doubt that some lawful order is indeed present. The 'crisis' mentioned above arises from this dual requirement: the form must be clearly lawful, but must not reveal a conceptual law. Conceptual treatment will clarify, for the mind, the nature of an event, and without such an explanation we feel that we do not yet understand what we are observing. Thus the phenomena of the physical sciences remain opaque to the mind, results of the working of unknown laws, until we have reached a conceptual analysis. Then the whole becomes (if our analysis is complete) transparently clear. This same sense of satisfying clarity, says Schiller, should accompany our perception of the beautiful, but it cannot originate, in this case, from conceptual analysis. The 'reflective understanding' should never be motivated, in fact, to seek for such conceptual explanation, since the immediate perception precludes it:

> The beautiful is a form that is self-explanatory; but self-explanatory means here to clarify itself without the help of a concept. A triangle explains itself, but only through the mediation of a concept. A serpentine line explains itself without the medium of a concept.
> One must say therefore that the beautiful is a form which demands no explanation, or which clarifys itself without a concept.[15]

In order words, a form which acts, for the mind, as if it were a synthetic-universal, an intuitive concept, in which thought and perception are one.

Since we are speaking of appearances rather than reality, there is no direct break with Kant in this, but it is dangerous ground. Even appearances are *some* type of reality (*qua* appearance), and Schiller does not manage to explain how such an appearance is constituted. He speaks of the *Nature* of a thing, or interchangeably, its *Person*, as the principle of determination of a self-determined thing, but his discussion of this usage is indeterminate, assigning to this *Nature* or *Person* the source of an object's uniqueness but clarifying no more than this. Once he has established the terminology however, he is not afraid to use it in a very positive manner. So we find that *Nature* is

> The inner principle of existence of a thing, or conjointly, when considered as the ground of a form: *the inner necessity of the form.*[16]

and "Nature in artistic presentation" is

> the pure harmony of the inner essence with the form, *a rule which is both given and observed by the thing itself.* (On these grounds the beautiful is the only symbol in the sense-world of that which is consumated or perfected in itself, for unlike the practical, it does not need to become related to something external, but it itself both commands and hearkens and brings its own law to fulfillment.)[17]

At this point, we cannot really accept this as Kantian even if it does refer to appearances rather than reality, and Schiller has taken an irrevocable step.

The phrase "Freedom in appearance" was meant to indicate that it is but apparent freedom, not real freedom, that is spoken of here. No deception is involved, of course, for Schiller follows Kant in claiming that art is not deceptive (except by accident, as when it may deceive an audience it was not intended for, let us say a young child). The viewer (of visual art) knows that he is not looking at something self-creating, but something man-made. What he delights in, according to Schiller's statements, is the harmony between the "inner essense" and the outer form, the <u>apparent</u> production from 'inside out.' The artist is therefore showing us what such production <u>would</u> look like, if it were actual. Let us dissect the example.

The term 'appearance' is applied to the image in order to differentiate it from a material fact. It looks like freedom, but it is not actually; true self-production is not really there. On the other hand, form of some kind <u>is</u> most certainly present, and we are to assume that this form is in harmony with an "inner essence." The latter entity must also, it would seem, be present as an actual quality of the 'appearance', even as is the form with which it harmonizes, or else the image could exhibit no such harmony, and therefore, no semblance of freedom.

In order to insure clarity on this point, let us take it from another angle. The thing to be imitated, to be shown in semblance, is freedom. Freedom would be self-production, and would appear in the sense-world through an object which exhibited to immediate perception both its inner determining principle and the outer form which obviously derives from that principle. The manner of imitation therefore, will be the creation of an image which exhibits these elements. (The image will be, of course, man-made, for the inner principle did not actually create the physical reality of the image, this being a result of human effort. Even so, the viewer, who recognizes that the image was man-made, may enjoy contemplation of the harmony between these two principles, i.e. contemplation of the beauty of the image. It is the presentation of the 'idea' he appreciates, not the physical fact.) But no 'appearance" is present unless these two elements constitute it. Thus it is not these elements, the determining principle and harmonizing form, which the artist creates a semblance of, but rather these which, by being present in the form of the image, create a semblance of freedom.

The inescapable conclusion is that the human mind must be capable of grasping both a form and a principle which may relate to that form as a rule which works from the whole to the parts. If the latter (the synthetic-universal) could not be thought, then neither could it be contemplated in a beautiful object, and no 'appearance' of freedom could be created. Schiller has overstepped Kant's limits without admitting it, but he will shortly correct that omission.

III Schiller and Goethe

Schiller's university training was that of a physician. He was impressed into the army as a doctor and sent to study medicine at the Military Academy of the Duke of Württemburg. The liberal attitude which prevailed there ensured that students would be confronted with a maximum diversity of views, and Schiller became familiar with the deductive methods of Descartes and Leibnitz as well as the inductive empiricism of the *Philosophes* and the common sense philosophy of Reid and Ferguson. One notable result of this exposure seems to be Schiller's sense that philosophy in his time could not reconcile the mental and bodily natures of man. His first dissertation, written in 1779, treated the problem of unification of these two aspects, but from this time until his first acquaintance with Kant, the problem seemed to him unsolved. Intensive study of the second Critique led him to new views of the matter. He thought, for a while, that Kant had successfully mediated the split between mind and body, rationalism and empiricism. With the publication of On Grace and Dignity in 1793, however, a few months before the Kallias letters, Schiller put forward what he took to be a challenge to Kant,[1] arguing that the senses must be nourished if the spirit is to be rich as well as pure. As we have already seen, he had been developing a position, during these years, which would represent a far more serious attack when it emerged from his private to his public writings.

A mediation between empiricism and rationalism was a general demand of the age, but Kant had attempted it without recourse to intuitive ideas, or indeed, upon the basis of their strict exclusion. The whole structure of the first Critique, and therefore of Kant's succeeding writings, is built from the founding notion of a human mentality which cannot rise to "intellectual intuitions," and cannot therefore mediate, knowingly, between body and mind. Whatever synthesis of these two may arise from faith and will, none can ever arise from knowledge itself, for the true ground of unity between the elements of man is the "super-sensible substrate" which one must, according to the laws of Reason, think, but can never know. The obvious alternative to such a position, namely, the postulation of intuitive mind, had not been attempted (except by Reid in Scotland), since Kant's criticism of 'postulated metaphysics' was too devastating to risk an encounter. Schiller himself felt this way for a good length of time, but eventually something pushed him into the effort. Critics offer various hypotheses as to what the spur actually was; most concluding that his own "poetic experience" was the decisive factor.[2]

We may, of course, search the Kallias letters for evidence of this. They are far richer than I have shown, and include a good many empirical examples. The question would remain somewhat doubtful by this route, however; for no matter how convinced we become of Schiller's own sense of experience, we could not tell, from the letters, whether this sense was correct or not, the empirical examples being entirely inadequate. The important question, at this point, is not Schiller's belief, but its truth or falsity. If men can think intuitively, if the mind is capable of synthetic-universals, then epistemology itself must undergo a profound change, and both aesthetics and science have new ground to investigate. There can obviously be only one manner of investigation of the question. Kant is correct in rejecting a postulated metaphysics; if intuitive capacity is present, it must be found empirically.

This is why, at this junction, we must turn from aesthetics to science proper. Here the question of empirical methods receives direct scrutiny, and the evidence we are seeking is more likely to come into view. The turn is not without historical precedent, however, for both Schiller and Goethe, the two greatest German writers of their period, led the way.

These two men, destined to become firm friends, did not meet until the surprisingly late date of 1794. They had, of course, read each others work long before that, but Goethe disapproved of the writings of the Romantic school, and, identifying The Robbers with it, avoided its author. Schiller was antithetical in his own way towards Goethe, and neither cared to bring about a meeting. Yet quite by accident, they met in 1794 at a lecture sponsored by the scientific society of Jena, and struck up a conversation. Goethe records the incident:

> By chance we left the hall together and he began a conversation. He appeared to be interested in the lectures, but remarked with great insight, and to my pleasure, that such mangled methods of regarding Nature could only repel a lay person who might be otherwise willing to venture into the subject.
>
> I answered that perhaps even to such experts such a method would be uncongenial and that there might be another way of considering Nature, not piecemeal and isolated but actively at work, as she proceeds from the whole to the parts. Schiller expressed the desire to have the point clarified through discussion, though not concealing his doubts and refusing to grant that my views owed their origin to experience.
>
> We reached his house; the conversation lured me in. I gave a spirited explanation of my theory of the metamorphosis of plants with graphic pen sketches of a symbolic plant. He listened and looked with interest, with unerring comprehension, but when I ended he shook his head, saying "That is not an empiric experience, it is an idea." I was taken aback and somewhat irritated, for the disparity of our viewpoints was here sharply delineated...Controlling myself, I replied, "How splendid that I have ideas without knowing it, and can see them before my very eyes!"[3]

The incident is almost too archetypal to accept. Schiller, replying, as Goethe says later, with the outlook of "trained

Kantian," cannot believe that an idea which goes beyond what one would call 'simple observation of sense,' or actually simple empiricism, can be an experience. He supposes that it is a hypothetical interpretation of the simple empiric observations supplied by the rational side of man. Goethe, who does not think in terms of this duality, cannot understand that his 'experience' is also an idea, and claims that he sees it before his very eyes! Schiller's position is one of unmediated duality, Goethe's of naive unity, and a 'dialectical friendship' has begun.

Schiller and Goethe continued this discussion in their letters, and within a shor time, Schiller, now thoroughly impressed with the wisdom of his friend's naivete, attempts to outline his mental character:

> My recent conversations with you have put the whole store of my ideas into a state of motion, for they relate to a subject which has actively engaged my thoughts for some years past. Many things upon which I could not come to right understanding with myself have received a new and unexpected light from the contemplation I have had of your mind. (for so I call the general impression of your ideas upon me). I needed the <u>object</u>, the body, to several of my speculative ideas, and you have put me on the track of finding it. Your calm and clear way of looking at things keeps you from getting on the by-roads into which speculation as well as arbitrary imagination--which merely follows its own bent--are so apt to lead one astray. Your correct intuition grasps all things, and that far more perfectly than what is laboriously sought for by analysis; and because this lies within you as a whole, the wealth of your mind is concealed from yourself. For, alas, we only know what we take to pieces. Minds like yours, therefore, seldom know how far they have penetrated, and how little cause they have to borrow from philosophy, which, in fact, can only learn from them. Philos-

> ophy can merely dissect what is given it, but the <u>giving</u> itself is not the work of the analyser but of genius, which combines things according to objective laws under the obscure but safe influence of pure reason....
> You seek for the necessary in nature, but you seek it by the most difficult route, and one which all weaker minds would take care to avoid. You look at Nature as a whole when seeking to get light thrown on her individual parts; you look for the explanation of the individual in the totality of all her various manifestations. From the simple organism you ascend step by step up to those that are more complex, in order, in the end, to form the most complicate of all--man--out of the materials of nature as a whole. By thus, as it where, imitating nature in creating him, you try to penetrate into his hidden structure. This is a great and truly heroic thought, which sufficiently shows how your mind forms the whole wealth of its conceptions into one beautiful unity.[4]

Goethe accepted the characterization, and Schiller, anxious to clarify fully the distinction between their two natures, went on, in a later letter, to characterize himself:

> I hover, as a hybrid, between ideas and perceptions, between law and feeling, between a technical mind and genius. This it is that, particularly in my earlier years, gave me a rather awkward appearance both in the field of speculation as well as in that of poetry; for the poetic mind generally got the better of me when I ought to have philosophied, and my philosophical mind when I wished to poetise. Even now it frequently enough happens that imagination intrudes upon my abstractions, and cold reason upon my poetical productions.[5]

Goethe had impressed Schiller as a man and an artist, but their discussions began on the topic of scientific method. What changes can we find here to compare with his former position that Goethe's sketch must represent not an experience but a hypothesis? There seems, for one thing, to be a tacit recognition of Goethe's claims in phrases like "Your correct intuition grasps all things" [italics mine], "Minds like yours... seldom know how far they have penetrated," "imitating Nature in creating him," and so on, for the studies in plant morphology that produced the sketch and its interpretation are an example of the general approach described. Schiller has modified his first stance quite early, it would seem, in what was to be a ten year discussion (he died in 1805).

Of course, if Schiller wanted a means of demonstrating that intuitive thinking was indeed possible, he could not have come by a better windfall than a great intuitive artist who had developed a method of investigating Nature compatable with his artistic production. It was almost a godsend that Schiller and Goethe began on the topic of empirical methodologies, for whether Schiller recognized it or not, this had become, by now, the crux of his aesthetic arguments. He needed assurance that Kant could actually be superseded on this point without danger of falling back into 'postulated metaphysics.' Given such assurance, he could proceed with the implications that the Kallias project had brought to his mind, the picture which is presented finally in the Letters on the Aesthetic Education of Man, a text which revises, not only Kantian aesthetics, but also Kantian morality.

When Schiller began the work of recasting the letters on aesthetic education (originally sent to his Danish patron some years before) in order to form a publishable treatise, he received, as part of his continuing correspondence with Goethe, a letter containing a small essay which Goethe introduces with the hope that Schiller, whose powers of thinking make him (Goethe) feel like a child, will undertake the labor to criticize. The title of the essay is "How far can the Idea that Beauty is Perfection allied with Freedom be applied to Living Organisms," and it treats briefly such questions as the role of subordination and coordination in the organism, limitations of free play of organic forces by particular actions, development of <u>character</u> within the sphere of beauty. "Do such questions not" asks one critic, "reflect the central problem of aesthetic education as Schiller finally posed it?"[6] More important, however, to our present concern, is the identification of beauty with the freedom and perfection of the forces of the organism. This is extremely close to Schiller's thesis in the <u>Kallias</u> letters (which are unknown to Goethe), but it is drawn from the sphere of natural science by a man who can back it up with empirical evidence of a much different sort than Schiller had been able to bring forward.

There are two portraits of Goethe in the <u>Aesthetic Letters</u>; one as the ideal artist of letter IX, and the other as the ideal scientist of letter XIII. The second portrait is worth quoting in full:

> One of the chief reasons why our natural sciences make such slow progress is obviously the universal, and almost uncontrollable, propensity to teleological judgments, in which, once they are used constituitively, the determining faculty is substituted for the receptive. However strong and however varied the impact made upon our organs by nature, all her manifold variety is then entirely

> lost upon us, because we are seeking nothing in her but what we have put into her with all the impatient anticipations of our reason. If, then, in the course of centuries, it should happen that a man tries to approach her with his sense-organs untroubled, innocent and wide open, and, thanks to this, should chance upon a multitude of phenomena which we, with our tendency to pre-judge the issue, have overlooked, then we are mightily astonished that so many eyes in such broad daylight should have noticed nothing. This premature hankering after harmony before we have even got together the individual sounds which are to go into its making, this violent usurping of authority by ratiocination in a field where its right to give orders is by no means unconditional, is the reason why so many thinking minds fail to have fruitful effect upon the advancement of science; and it would be difficult to say which has done more harm to the progress of knowledge: a sense-faculty unamenable to form, or a reasoning faculty which will not stay for content.[7]

Again we see the only enemies: crude empiricism and speculative rationalism, but now they are both transcended by something else — a man who knows how to 'read' the phenomena themselves. It may be useful to compare the passage above (published in 1795) with Schiller's analysis of his friend's science as contained in their correspondence (of 1798). Schiller proposes to test each type of thinking, simple empiricism, rationalism, and Goethe's dialectical unity of the two, "according to the categories" of the first Critique. (If he has dropped the Kantian limitations, he has not been able to dispense with Kantian architecture.) He begins with "common empiricism," asserting that this pole, taken in its crudest form, is nothing but the immediate perception of sense in an isolated instance. As such, it cannot really claim experience, for it shys away from the rational power of combination (and of course, the 'empiricists' of his day lean toward it). On the other hand, rationalism gives birth to the "philosophical phenomenon" and the possibility of error. (In a simple judgment of sense, after Aristotle, there can be no error, but this possibility is called into existence by the act of synthesis.) Arbitrariness is the chief danger, for the thinking faculties have their own habitual bent, and are inclined to substitute themselves for the object under examination. We come finally to "rational empiricism":

> The pure phenomenon which, as I think, is one with the objective law of nature, can be got at only be rational empiricism. But, to repeat it again, rational empiricism can never begin directly with empiricism; on the contrary, rationalism will in all cases first lie between them. The third category arises at all times from the union of the first with the second, and thus we also find that it is only the full activity of freely thinking faculties together with the purest and most extensive activity of the sensuous powers of perception, that leads to scientific knowledge. Rational empiricism consequently will effect both these things: it will exclude arbitrariness and call forth liberality: the arbitrariness which influences the mind of man towards the object, or blind chance in the object and the limited individuality of the single phenomenon towards the power of thought. In a word, it will grant the object its full right by taking from it its blind power the accidental in the single case , and procure for the human mind its full (rational) freedom by cutting it off from all arbitrariness.[8]

Not only the 'perfect scientist' of the aesthetic letters, but also the notion of the "aesthetic state" is recognizable here. Compulsion, from whatever quarter, sensible or rational, has vanished, and a third power has entered which turns out to be the perfection of both the sensible and rational parts of man. Readers of the aesthetic letters will remember that Schiller returns no less than nine times to the demand for a 'third thing,' resolving a whole series of oppositions, and that the elusive 'third' which is forever reappearing as the needed element is eventually found in a unity of the will (<u>Spieltreib</u>) which perfects both the sensible and rational natures and ends their opposition, bringing them, in a heightened and more perfect form, into a unity. But here, instead of the aesthetic state of the creative artist, it is the contemplative state of the scientific observer that is described. The seeming contradiction (a scientist should certainly not act as a creative artist when attempting to discover the true nature of his object) is easily resolved when one recalls that the concept of "aesthetic state," while perfectly modeled in the act of creation, is also applied to the act of appreciation. Not only the painter of a picture, but his audience as well, must reach such a state in order to meet the demands of their respective roles. The scientist, it would seem, must reach what seems to be an "aesthetic state" in order to 'appreciate' the nature of his perceptions, even as the gallery-visitor must attempt to 'put himself in tune' with the paintings by discovering their diction.

The fact that we are speaking of a type of aesthetic state helps explain why Schiller talks of a <u>pure phenomenon</u> which is "one with the objective law of nature." The law must be, for the mind, a rule, but here it is also a phenomenon. It is discovered therefore by an intelligible perception, an _aisthesis_ (we remember the notion, in the _Kallias_ letters, of a perception which was an idea as well, a form which explained itself). Even so, if we look into Goethe's writings for evidence of this, it is easy to locate the type of thing that Schiller must be speaking of. In an essay upon his morphological method, Goethe writes

> In Dr. Heinroth's book on anthropology, a work to which we shall return repeatedly, the author speaks favorably of my character and work. Indeed, he calls my method of procedure unusual, saying that my capacity for thinking is _objectively_ active. By this he means that my thinking is never divorced from objects, that the elements of the objects and my observation of them interpenetrate, become fused in the process of thought; that my observation is itself a thinking, and my thinking is a way of observation; and this is a method to which my friend Heinroth gives his approval.[9]

After presenting some recollections drawn from his practice as a poet, he presents this example from his scientific work:

> It was likewise with the concept that the skull consists of vertebrae. The three hindmost parts I soon recognized, but not until the year 1791, when I picked up a battered sheep's skull from the sand of a dunelike Jewish cemetery in Venice, did I realize that the facial bones likewise could be interpreted as originating from vertebrae. _I clearly saw_ the transition from the first wing-_bone to the_ ethmoid and the conchae, and thus had a view of the whole in its most general aspects. [italics mine][10]

He also, according to his words to Schiller, "saw" the idea of an archetype of plants "before my very eyes." The claim to intelligible _sisthesis_ is impossible to miss, although its nature is not yet clear.

The concept of an aesthetic method of thought (intuitive) was refered to by both Goethe and Schiller by the verb darstellen: to present or represent. Schiller termed the mode of thinking which grasped the whole rather than the separated parts "darstellend denken" (thinking presentationally). Goethe was fond of warning that, unlike discursive analysis, morphology "nur darstellung und nicht erklären will" —is aimed only at presentation rather than discursive explanation.[11] Agnes Arber, a British morphologist who made a study of Goethe's work and of the meaning he ascribes to this key term (darstellen), tells us:

> as used in morphology it may perhaps be rendered by the phrase interpretative portrayal, or internalised representation. The morphologist has to aim at what the portrait painter achieves when he adds intellectual insight to the mastery of technique, so that his picture becomes a revelation of personality, as seen through, and expressed in, the external linaments.[12]

Writing upon the intention of his morphology, Goethe reviews the admitted successes of the mechanical methods of natural science (those which Schiller termed "mangled"), praises them, but then continues:

> But these analytical efforts, continued indefinitely, produce many disadvantages. The living may indeed be separated into its elements, but one cannot put these back together and revive them. This is true even of inorganic bodies, not to mention organic ones.
>
> For this reason, the urge to cognize living forms as such, to grasp their outwardly visible and tangible parts contextually, to take them as intimations of that which is inward, and so master, to some degree, the whole in an intuition, has

> always arisen in men of science. How closely this scientific demand is tied to the artistic and imitative impulses need not be worked out in detail.[13]

That these things are indeed very close however, Goethe admits in the introduction of his Farbenlehre:

> Indeed, strictly speaking, it is useless to attempt to express the nature of a thing abstractly. Effects we can perceive, and a complete history of those effects would, in fact, sufficiently define the nature of the thing itself. We should try in vain to describe a man's character, but let his acts be collected and an idea of his character will be presented to us.[14]

(The character being "that which is inward," and the acts the "intimations.") The identification of his own method, when applied to human character, and the work of the novelist or biographer is obvious. Of course, the creative artist, the novelist, would not only collect but invent the acts portrayed, whereas the biographer and Goethean scientist would but collect what nature provides. The 'reading' of the result however, is the same in all cases, and demands a certain type of aesthetic state, in which the mind grasps the whole in order to interpret the parts, rather than the other way around.

Here we have Schiller's program of the Kallias letters being repeated in terms of scientific method. His "inner essense" or "Nature" or "Person" (character?) is the intuition of the whole, and this is expressed in the external form (outward parts). The rule of the object is found in a perection that is also a thought, a phenomenon that clarifies (presents) itself without discursive explanation, and, most important of all, works from the unity of the whole to its parts. This last is a demand which is characteristically Goethean. He was never, as he once remarked to Falk, able to be satisfied with an aggregate of pieces:

> What do the pieces help me? or their names? I want to know what so inspirits every single part that it seeks out the other, either to serve or to command it, according as the law of reason innate in all things qualifies, to a higher or lower degree, this for this role, that for that. But just upon this point there rules an overall silence.[15]

If there can be any further doubt that Goethe is speaking of synthetic-universals, we may secure his direct testimony on this very point. Schiller insisted that he read Kant, and so he did. The three *Critiques* were difficult going for a man as philosophically naive as Goethe, but he dutifully worked through them, finding little to his liking until he reached the third. Here he felt some sympathy for the problems treated, and especially for Kant's rejection of the simple-minded teleology that was then rampant in the sciences. One passage caught his attention in particular however, for it seemed to relate directly to his own work. Here he even dared venture into print in opposition to the great philosopher:

> the following passage 3rd Critique was highly significant to me:
> "In contrast to our own analytical intellect, we can conceive of an intuitive one which proceeds from the synthetically universal (the concept of the whole as such) and advances to the particulars, in other words, advances from the whole to its parts...At this point it is not necessary to prove that such an *intellectus archetypus* is possible,

> but merely that we are inevitably led to it when we contrast our own analytical, image-requiring intellect (intellectus ectypus) with its own fortuitous character, and that the idea of an <u>intellectus archetypus</u> would contain no contradiction."
> To be sure, the author seems to be referring to godlike understanding; yet since it is possible in the moral realm to ascend to a higher plane, drawing close to the Supreme Being through faith in God, virtue, and immortality, the same might well hold true for the intellectual realm. Through contemplation of ever-creative Nature we might make ourselves worthy of participating intellectually in her productions. Had not I myself ceaselessly pressed forward to the archetype, though at first unconsciously, from an inner urge; had I not even succeeded in evolving a method in harmony with Nature? What then was to prevent me from courageously embarking upon the adventure of reason, as the old gentlemen of Königsberg himself calls it?[16]

The interpretation of the second and third <u>Critiques</u> is not here an issue. For our purposes, it is Goethe's claim to empiric verification of an "archetype," an intuitive concept, that forms the important content of the passage.

For some, Kant might be interpreted in such a manner as to allow the widest degree of freedom, even to the point of a postulation of intuitive insights. Many later thinkers were and are yet fond of such looseness, and Goethe seems to be appealing, in the quote above, to such an interpretation. (But not, as I have already mentioned, on the <u>basis</u> of this interpretation. The foundation of Goethe's appeal is empirical, and thus he does not really have to appease the Kantians.) Schiller made less fuss about the matter. As soon as he had reassured himself, through Goethe's work, that his leaning towards intuitive thought was not merely a speculative dreaming, but could actually be supported by scientific experience (experience made rigorously self-reflective), he let go of Kant's limitations once and for all. The Aesthetic Letters are not, as Hegel noticed, subservient to the Critiques. Kant is utilized there with critical intent, but has been left behind in the positive synthesis. As Schiller wrote in 1795:

> Whenever it is a question of merely demolishing, or of attacking other people's dogmas, I have proceeded on strictly Kantian lines. Only where I am concerned to build something new of my own do I find myself in opposition to him.[17]

The accomplishment of the Critiques could still be very useful in separating mere postulation from actual evidence. Schiller would no longer be bound within their limits however, and in 1796 he wrote the following distich for publication in Xenien and addressed to Kant:

> Zwei Jahrzehnte kostet du mir: zehn Jahre verlor ich
> Dich zu begreifen, und zehn, mich zu befreien von dir.
>
> Two decades you cost me: I lost ten years
> To grasp you, and ten, to free myself from you.[18]

IV Goethe

In his Maximen und Reflexionen Goethe wrote

> The beautiful is a manifestation of secret laws of Nature which, without this appearance, would remain forever hidden.[1]

What he means by this may be more closely seen when it is compared to two following statements:

> Beauty requires that a law come to manifestation.
> The Rose for example.
> In the blossom the law of vegetable growth comes to its highest appearance, and the Rose is but the pinnacle of this appearance.
> The pericarp can still be beautiful.
> The fruit can never be beautiful, for here the vegetable law reverts to itself (into simple law).[2]
>
> The law, which comes into manifestation in the greatest freedom and according to its own conditions,

> brings forward the objectively-beautiful, which must, of course, find a worthy subject by whom it may be perceived.[3]

Schillor had spoken, in the Kallias letters of the process of idealization, by which the artist enhances an ordinary reality into a beautiful image, bringing the essential nature of the object into appearance. This 'nature' was, as we saw, a type of inward law or rule. Goethe applies the same relations to nature, finding that the beautiful is always a manifestation of law, and qualifying this with the addition that such law must be shown in the immediate appearance of the object, and that it must manifest "according to its own conditions" (freedom). Thus the beautiful in nature arises when conditions are such that they allow the organism (speaking only of the beauty of living things) to reveal its inward law in the outer form. This happens, in the case of plants, most often with the flower, least, it would seem, with the fruit (I think it is the fruit of the rose itself that he is speaking of in the selection). Of course, the conditions of growth determine whether this inner law may come to greater or lesser manifestation:

> Her intentions Nature's are always good always aimed at manifestation of law but not so the conditions necessary to make these manifest. The oak, for instance, is a tree that can be very beautiful. But what a favorable juncture of circumstances is required before Nature succeeds for once in producing a truly beautiful specimen![4]

The artist is dependent upon his materials and his own skill. These are limitations, but if the skill is great, he may hope to surpass the degree to which Nature is able to manifest her laws in her own material, for she is everywhere dependent upon local conditions. Plants, for instance, do not grow under optimum conditions. They may be bent, stunted, etc. by the forces of their environment, and no one stands by to see that this does not happen. The artist, however, aims at a mere semblance of the reality that is Nature's intention, although not her accomplishment, and therefore has the chance of succeeding in his endeavor that Nature lacks. Because of this relation, the artist cannot be satisfied with mere imitation, but must aim at something higher than the natural productions about him:

> It is the highest task of every art to employ appearance to create an illusion of a higher reality. But it is a false endeavor to carry the realization of appearance to such a point as to leave nothing in the end but ordinary reality.[5]

The "higher reality" is, of course, a more perfectly realized object than that found in nature. The mistake, carrying one's imitative work so far that reality rather than ideality begins to be imitated.

This is identical with Schiller's notion, and it is also quite similar to any number of Neo-Platonic aesthetic theories. Schelling and Hegel will also put forward a similar line. It should raise little wonder that Goethe's writings did not attract much historical notice. A historical commonplace, an addenda to Schiller, a preparation for Idealist aesthetics, or for some, an example of the thinking of one of Germany's most balanced human beings, a man who set a mark for personal culture which is still an ideal for those who care for such things. But where, in any of this, do we find something to develop, a possibility yet to be investigated?

Actually, the 'possibility' I am speaking of is quite easily seen when one looks at the picture from the correct angle. It is a habit of most modern readers however (including critics), to assume that whatever sounds traditional or Idealistic is also purely speculative. Even so, the "law of vegetable growth" is, to most minds, just what it first seemed to Schiller, an idea _rather_ than an empiric experience, these two things being distinguished from each other by exclusive alternation. The aesthetic theory behind Goethe's remark about 'law' cannot be so interpreted, as we have seen, for it requires that the 'law' be both idea and empiric experience — that it act as a rule and also 'appear.' Let us examine Goethe's "law of vegetable growth" more closely.

The notion appears, for the first time, in his _Italian Journey_. Goethe had become an amateur botanist by the time of his sojourn in Italy. He had gone to the south to study art and escape the 'prison' that court life at Weimar seemed to him at the moment, but he begins making observations on plant life while still in the Alps. (He took his Linnaeus with him.) Further comments are to be found scattered through the whole of the text. They show a definite development, which, interestingly enough, runs parallel to a similar endeavor regarding Greek sculpture.

The selections are prefaced with place and date.[6]

Padua Botanical Gardens
September 27, 1786

To wander about among a vegetation which is new to one is pleasant and instructive. It is the same with familiar plants as with other familiar objects; in the end we cease to think about them at all. But what is seeing without thinking? Here where I am confounded with a great variety of plants, my hypothesis that it might be possible to derive all plant forms from one original plant becomes clearer to me and more exciting. Only when we have accepted this idea will it be possible to determine genera and species exactly. So far this has, I believe, been done in a very arbitrary way. At this state of my botanical philosophy, I have reached an impasse, and I do not see how to get out of it. The whole subject seems to me to be profound and of far-reaching consequence.

Rome; in the company of artists
January 20, 1787

I am fairly well up in anatomy and have acquired some knowledge of the human body, though not without much effort. Now, thanks to my constant observation of statues, I find myself more and more interested in the subject at a more serious level. In surgical anatomy, knowledge of the part is the only thing which matters, and for that, one wretched little muscle is quite sufficient. But in Rome the parts are of no account except in so far as they contribute to a shape which is noble and beautiful...

I am also educating myself by following the customs of the ancients and studying the skeleton, not as an artificially assembled mass of bones, but with the natural ligaments to which it owes life and motion.

Rome
January 28, 1787

the art of the Greeks: What was the process by which these incomparable artists evolved from the human body the circle of their godlike shapes, a perfect circle from which not one essential, incidental or transitional feature was lacking? My instinct tells me that they followed the same laws as Nature, and I believe I am on the track of these. But there is something else involved which I would not know how to express.

Rome
February 16, 1787

What new joys and profitable experiences the southern regions of this country must have in store for me! It is the same with the works of Nature as with the works of art: so much has been written about them and yet anyone who sees them can arrange them in fresh patterns.

Botanical Gardens, Palermo, Sicily
April 17, 1787

Here where, instead of being grown in pots under glass as they are with us, plants are allowed to grow freely in the open fresh air and fulfil their natural destiny, they become more intelligible. Seeing such a variety of new and renewed forms, my old fancy suddenly came back to mind: Among this multitude might I not discover the Primal Plant? There certainly must be one. Otherwise, how could I recognize that this or that form _was_ a plant if all were not built upon the same basic model?

I tried to discover how all these divergent forms differed from one another, and I always found that they were more alike than unlike. But when I applied my botanical nomenclature, I got along all right to begin with, but then I got stuck, which annoyed me without stimulating me.

Naples, in a letter to Herder
May 17, 1787

A word about Homer. The scales have fallen from my eyes. His descriptions, his similes, etc., which to us seem merely poetic, are in fact utterly natural though drawn, of course, with an inner comprehension which takes one's breath away. Even when the events he narrates are fabulous and fictitious, they have a naturalness about them which I have never felt so strongly as in the presence of the settings he describes. Let me say briefly what I think about the ancient writers and us moderns. _They_ represented things and persons as they are in themselves, _we_ usually represent only their subjective effect; _they_ depicted the horror, _we_ depict horribly; _they_ depicted the pleasing, _we_ pleasantly, and so on. Hence all the exaggeration, the mannerisms, the false elegance and the bombast of our age. Since, if one aims at producing effects and only effects, one thinks that one cannot make them violent enough. If what I say is not new, I have had vivid occasion to feel its truth...

I must also tell you confidently that I am very close to the secret of the reproduction and organization of plants, and that it is the simplest thing imaginable. This climate offers the best possible conditions for making observations. To the main question — where the germ is hidden — I am quite certain I have found the answer; to the others I already see a general solution, and only a few points have still to be formulated more precisely. The Primal Plant is going to be the strangest creature in the world, which Nature herself shall envy me. With this model and the key to it, it will be possible to go on forever inventing plants and know that their existence is logical; that is to say, if they do not actually exist, they could, for they are not the shadow phantoms of vain imagination, but possess an inner necessity and truth. The same law will be applicable to all other living organisms.

Rome; second visit
July 31, 1787

While walking in the Public Gardens of Palermo, it came to me in a flash that in the organ of the plant which we are accustomed to call the <u>leaf</u> lies the true Proteus who can hide or reveal himself in a vegetal forms. From first to last, the plant is nothing but leaf, which is so inseperable from the future germ that one cannot think of one without the other.

August 23, 1787

At long last the alpha and omega of all things known to us — the human figure — has come to grips with me and I with it...At least I have arrived at an idea which makes many things easier for me. To tell you all the details would be too complicated, and in any case, it is better to do than talk. It amounts briefly to this: my obstinate study of Nature and the careful attention I have paid to comparative anatomy have now brought me to a point where I have a vision of many things in Nature and sculpture as a whole which professional artists can arrive at only by a laborious study of the details, and even if they at last succeed in getting there, their knowledge is something for themselves only, which they cannot communicate to others.

September 6, 1787

I have hit upon an <u>en kai pan</u>*, in botany especially, which amazes me. What its full implications will be, I cannot yet forsee.

The principle, by which I interpret works of art and unlock the secret which artists and art experts since the Rennaissance have been laboriously trying to discover, seems to me sounder every time I apply

* <u>one and all</u>

> it. It is verily the egg of Columbus. Without going so far as to claim I know how to use the master key properly, I find myself competent to discuss with artists the details of their work, to see the point they have reached and what their difficulties have been. My own door stands open and I stand on the threshold, but alas, I have only time to peer into the temple before I must depart.
> from Rome
> One thing is certain: all the artists of antiquity had as great a knowledge of Nature and as unerring a sense of what can be represented and how, as Homer. Unfortunately, the number of works of the first order still extant is much too small. But once one has seen them, one's only desire is to get to know them through and through and then depart in peace. These masterpieces of man were brought forth in obedience to the same laws as the masterpieces of Nature. Before them, all that is arbitrary and imaginary collapses: there is Necessity, there is God.

As the reader may easily follow for himself in the quotes, the thought of an archetypal principle in botany becomes the general notion of a synthetic-universal as a natural principle. Since Goethe finds it, in particular, in organic formations, it seems that he is turning to an idea close to the Aristotelean entelechy, and indeed, in his old age he remarked "Nature cannot do without the entelechy,"[7] indicating that the term was proper to his organic unity. The manner in which the idea is developed however, is extremely interesting.

In the two cases traced above, Goethe has begun with a perceived or intuited unity: "how could I recognize that this or that form was a plant if all were not built upon the same basic model;" "the circle of their godlike shapes, a perfect circle from which not one essential, incidental or transitional feature was lacking." To be sure, one must have already trained one's eye to some degree to be asking such questions, but up to this point the training was not self-reflective. Having defined the problems, Goethe takes the steps he deems necessary to investigate them further, namely, botanical field research, and the study of general anatomy and bone structure in particular. He is looking for a comparable principle in both cases, and uses a comparable method (morphological examination), but in the first situation he is asking a 'biological' question, and in the second an 'aesthetic.' Or can we distinguish in this way?

The problem of the Greek sculptures is as much a problem of comparative anatomy of human bodies as the botanical question is of comparative anatomy of plants. We cannot separate the biological on the one hand and the aesthetic on the other, for they are both contained in the anatomical research. As the idea comes forth, it not only sheds its light on both Greek art and botany, but illuminates Homeric poetry as well. In the last entry, we find that the principle, according to its discoverer, became clear in botany especially, but will interpret works of art and unlock long-sought-for secrets.

After his return to Italy, Goethe published his botanical observations in the form of a small pamphlet, entitled <u>An Attempt to Explain the Metamorphosis of Plants</u> (which in later editions became simply <u>The Metamorphosis of Plants</u>). No direct claim of an 'archetype' is put forward here, but the idea is implicit in the evidence. Goethe traces the formation and transformation of stem-appendages, showing that each element (stem-leaf, sepal, petal, etc.) may be considered a transformation of any of the others, and that all seem to be metamorphic products of a common form, evidently the entity upon which all plants are based. The pamphlet marked the beginning of what has been termed "idealistic morphology." Although support was slow in manifesting, by the time of his death Goethe's botanical work had attracted notable supporters.

Hegel writes of this text:

> Goethe's Metamorphose de Pflanzen marks the beginning of a rational conception of the nature of plant-life, in that it has forced attention away from a concern with mere details to a recognition of the unity of life.[8]
>
> Goethe with his great insight has defined the growth of plants as a metamorphosis of one and the same formation. His work, The Metamorphosis of Plants, which appeared in 1790, has been treated with indifference by botanists who did not know what to make of it just because it contained the exposition of a whole. The going forth of the plant from itself into several individuals is at the same time a total structure, an organic totality...
> what Goethe aims to do is to show how all these different parts of the plant are a simple, self-contained basic life, and all the forms remain only outer transformations of one and the same identical fundamental nature, not only in the Idea but also in their existence, so that each member can quite easily pass over into the other;[9]

The work has made, it would seem, a seminal contribution to biology as a whole, and concerning its subsequent historical status, Ernst Cassirer could write in the thirties:

> Goethe's theory of metamorphosis has profoundly affected the development of biology. In no other field of natural science have his ideas exerted so deep and fruitful an affect...The magnitude of his

> accomplishment is no longer in doubt today; opinion is well-nigh unanimous.[16]

The unanimity above is limited, of course, to the question of Goethe's contribution to biology.

We do not ask that a philosophic concept defend itself upon the same ground as an empirical hypothesis. The philosophical lies behind the scientific and is general rather than specific. Philosophical positions are implicit in the manner that one goes about asking an empirical question, and cannot, due to this fact, be themselves reduced to empirical questions. Kant taught this lesson well. But even this, it now seems, may suffer some modification.

Goethe's statement about the relation of the "vegetable law" to the form of the plant is usually read, by aestheticians, as a speculative idea. I am quite sure that Goethe himself could not conceive that the statement would be understood without reference to his <u>Metamorphosis of Plants</u>, in which text the "vegetable law" is morphologically discovered. And since the morphological demonstration is the basis to the claim that such a law is apparent in the phenomena, the validity of the remark above depends upon the validity of the botanical thesis.

But look what has happened. Goethe has taken an important philosophic stance, namely, that one may proceed upon the basis of intuitive concepts. Kant had previously criticised that stance, pointing out that what one merely <u>postulated</u>

could not constitute knowledge; only actual experience, made intelligible through concepts, could do so. Goethe accepts the criticism but points out that, given that intuitive concepts were part of human experience, one might proceed upon their basis without violating the principle of experience. He then claims empiric experience of such concepts.

The Kantian criticism has been properly by-passed by this move, _if_ the latter claim can be substantiated. How would one provide the necessary evidence? Only by empirical confirmation, since the point to be proven is a claim to perceptual experience. But this places an extremely basic philosophic question upon empirical grounds, and we have already noted that we do not discover first principles empirically! The answer to our perplexity here is to be found in the relation of the limit set by Kant — that the mind is incapable of intuitive concepts - to his dictum that first principles are always assumed before an empirical investigation rather than revealed by it. It would seem that the latter dictum depends upon the former limitation. It is just the lack of intuitive concepts that causes science to depend upon previously established _a priori_ principles in order to exist.

Some limitations are self-perpetuating. If we assume that science must be Kantian science, then naturally we cannot go looking for intuitive concepts. The only manner in which we could look would be empirically (since they are perceptions as well as thoughts), but we already hold that all we can look _for_ in an empirical investigation is a conceptual analysis of the phenomena based upon _a priori_ guides. In order to see our way clearly to the investigation that Goethe makes, we must remember that, to begin with, he is questioning whether science must be Kantian, for the question of the existence of synthetic-universals is logically prior to that of the nature of science. If we forget this rather important sequence of priorities, we may mistakenly criticize Goethe's work from a position which is itself placed in question _by_ that work.

Perhaps this is why Cassirer says nothing about this point, and why so many philosophers of science and scientists have read Goethe to no further end than to remark that he 'did not really understand Kant,' or that 'his work rests upon very questionable speculation,' or even that 'to claim that one has an idealistic science (as Goethe did) is to join contradictory terms.' All such views rest upon the presupposition that intuitive thinking is _not_ possible, and fail to see that this is the very thing in question, since the above assumption will not allow one to conceive of a scientific method which _could_ question it.

In my bibliographical searches I could not find one article which put forward the view that the validity of Goethe's aesthetics was dependent upon the validity of his morphological studies; such is the strength of established thought.

V General Summary and Conclusion

Kant had noticed, and rather accurately described, what we may term the problem of aesthetic 'diction.' He had treated this special arrangement of perceptual elements subjectively only, saying that the aesthetic object produced, in the appreciative subject, a sense that its 'diction' was a unified whole, springing therefore from a single principle, Kant denied, however, that such a principle could ever be known, attributing the impression of a diction to a method of looking, or 'manner of representation,' but telling us nothing whatsoever about the objective qualities of the object that could be so represented.

Schiller, in attempting to expand upon this, thought to qualify the object without going beyond Kant, but found this task beyond his means. He was drawn inexorably, perhaps on the strength of his own experience as an artist and critic, to the postulation of an organizing principle behind the diction. He is unable to discover any other explanation for his own very clear sense of the unity of an aesthetic form, which unity seems to him apparent even if we cannot discover the cause (that actual principle behind the unity). Since the 'illusion' involved in art is not constituted in the formal relations of the perceptual elements, but rather in the relation of the imitative construct to actual reality, Schiller may not make these formal relations into a mere subjective seeming, but must accept them as actual. He has no method, however, by which to justify this stance.

Goethe not only accepts the notion of an actual unity in the formal relations of elements of both aesthetic and organic form, but develops a method to demonstrate this unity in the organic realm. The method is empirical, but is based upon the very thing that it aims at demonstrating, namely, intuitive principles. These are found by an analysis of the perceptual form, much in the manner that the geometrician discovers the relations between his lines by direct investigation, the difference being that while the geometer's relations are not expressed in intuitive concepts, those of the idealistic morphologist are.

At this point in the history of aesthetics a turn is made that is, I think, missed by the historians of the field. The question undergoing development is clearly whether a principle capable of comprehending (that is, unifying) an aesthetic diction can be conceived. This problem is itself independent of any theory of beauty that may utilize the answer in a larger frame, for it is prior to such a theory. It is not, then, a theory of beauty, whether by Schiller or Goethe, that I am attempting to bring to light, but only the question that they both found to have a logical priority to the question of beauty as they would ask it. We may, I think, recognize the examination of <u>form</u> alone, and particularly the question of the relation of 'inner' form to outer, as a problem for aesthetics in its own right. But it is this very question that can now be seen to rest upon empirical grounds.

Clearly, Goethe's contention that he has demonstrated the existence of an intuitive unity in the 'diction' of plant form (and his subsequent use of such a principle as the basis of his aesthetics) deserves critical estimation. Yet such estimation can only be made by critical study of his scientific, rather than aesthetic , writings, for he left no text of aesthetics. Historical recognition of his somewhat unusual situation being lacking, the work remains to be done.

PART II

I Metamorphosis

The sketch that Goethe drew for Schiller was not the result of a cursory investigation of Botany. Goethe had already produced his major work in the field, the *Metamorphosis of Plants*, and had pondered the questions of methodology and results for some years already. He gives us a small history of his botanical development up to the production of the *Metamorphosis* text in a number of short essays he wrote after its publication, and these pieces are really the best introduction to the text proper. Because this chapter is concerned with making a close reading of the *Metamorphosis of Plants*, it is only prudent that we enter by means of the evolution of thought outlined in the historical essays.

(a) The evolution of the idea

Goethe mentions, in a history of his botanical studies, that he gained his first scientific interest after his reception into a "distinguished Weimarian circle," wherein scientific knowledge was cultivated. Among these members of the court of Weimar he found one Dr. Bucholz, the only pharmacist in Weimar at the time, who tutored Goethe in chemistry. Following his own researches into the curative power of herbs, this man had become somewhat dependent upon Linnaean botany (which supplied the best taxonomic classifications for field recognition), for which he, and others of his circle, had great admiration. This they passed on to Goethe, who made field trips in their company, and had the benefit, in the field or at Weimar, of a continual theoretical dialogue. (The Jena group was not philosophically educated, and we may safely assumed that their 'theory' remained, although sophisticated in empirical particulars, philosophically naive.)

None of his new friends were willing to go beyond Linnaeus, and Goethe, like them, accepted the Linnaean manner of analysis "with complete trust" during his apprenticeship. But in time difficulties arose:

> I gradually became aware that some things on the path which I had marked out and I had taken, were holding me back, if not actually leading me astray.
> If I am to become consciously articulate about these circumstances, let the reader think of me as a born poet, who, in order to do justice to his subjects, always seeks to derive his terminology from the subjects themselves, each time anew. Imagine that such a man is now expected to commit to memory a ready-made terminology, a certain

> number of words and bywords, with which to classify any given form, and by a happy choice to give it a characteristic name. A procedure of that sort always seemed to me to result in a kind of mosaic, in which one completed block is placed next to another, creating finally a single picture from thousands of pieces; this was somewhat distasteful to me.[1]

The reader may have noticed that the 'mosaic' description is an obvious parallel to the conceptual procedures in an inorganic science, let us say, mechanics. Here indeed the perceptual pieces are assembled by means of concepts which simply <u>add</u> them, one to another, and the whole, as Kant pointed out, is the sum of the added parts. Linnaean classification takes account of leaf-shape, stem formation, leaf orientation on the stem, flowering parts (shape, color and number) and fruit. Types are constructed by grouping together those plants which resemble each other in these terms (sometimes, for example, by the <u>number</u> of stamens). Features used for such classification had to be fixed, of course, thought of as building-blocks of the whole, the entirety of the plant being no more, at least as far as this taxonomy was concerned, than the sum of these blocks. But plants are not static entities. They grow, and during growth, change their appearance. The individual organs also change during growth, and the entire organism has a rather plastic appearance. It does not <u>feel</u> static, nor suggest a static terminology to the mind. When the plant is actually before us, the Linnaean system has a way of seeming somewhat arbitrary.

The Linnaean approach was unsatisfactory even to its author, who was interested in passing beyond its 'artificial' character to a more 'natural' taxonomy. But it did supply a tool for the recognition of an enormous number of plants; an invaluable help in the field. Goethe continues his narrative:

> To be sure, I recognized the necessity of this procedure, which had as its goal the discussion of certain external plant phenomena, according to general agreement, and the elimination of all phenomena which are uncertain and difficult to represent. Nevertheless, when I attempted an accurate application of terminology, I found the variability of organs the chief difficulty. I lost the courage to drive in a stake, to fix a boundry line, when on the selfsame plant I discovered first round, then notched, and finally almost pinnate stems, which later contracted, were simplified, turned into scales, and at last disappeared entirely.[2]

In order to follow exactly here, it will be very useful to see what is being spoken of.

In Figures 1,2,3, of Plate I we have, respectively, a smooth margined leaf (which margin would be shared by Goethe's "round" leaf), a notched leaf, and a pinnately-compound leaf (formed of pinnate leaflets). These schema are limited to the mid 'rib' or central vein, the major branching veins, and the outer margin of leaf tissue. The plant he speaks of would begin with the production of smooth-margined leaves (near the bottom of the stem and thus chronologically earliest in their appearance), continue with a gradual development of notching (as the leaves get higher on the stem; not the same leaves, but subsequent ones) which notches on even higher leaves would almost isolate a leaflet upon its own mid-vein ("almost pinnate").

After this progression toward pinnate development, the plant then went away from it again, producing, of the still higher regions of the stem, a progression of leaf-forms which lead back to smooth margins and finally to "scales" rather than true leaves.

The pinnateness of my sketch (Fig. 3) is total, each leaflet being isolated on its own stem (a section of the mid-vein without surrounding leaf-tissue). The leaf of Fig. 4, while developing notches that go to the mid-vein, does not either isolate its resultant leaflets on their own stem or even organize them about one major branch-vein, thus falling a long way short of true pinnate formation while still notching to the mid-vein. The examples of Fig. 5 (all of the same species of plant) range from smooth, to notched, to such a close approximation of pinnate isolation (lacking only the removal of a very small zone of tissue) that it is difficult to maintain that the leaves are only 'deeply notched.' Fig. 6 is a fully pinnately-compound leaf, each leaflet quite isolated. Since the difference between a smooth-margined leaf and a pinnate leaf is simply a matter of tissue growth (or the lack of it), the vein or rib pattern being essentially identical, it is obvious that it would be structurally possible to construct a progressive series of leaf-forms, beginning with smooth margins and moving by small gradations to full pinnate development. Such a series would seem to the eye, like 'snapshots' fixing a number of stages in what was actually a continuous transformation: as if, that is, the reality before the eye was not that of a number of separate individuals but rather continuous 'movement.'

On Plate II we find three leaf-series picked, in ascending order on the stem left to right, of the common groundsel (Senecio vulgaris: the rows A,B, & C are picked from three different plants). The transition of leaf-forms from the lower stem region to the higher shows us something of the sort of transition Goethe had before him. The first leaves are small, fairly smooth, spoon-shaped. As they sprout, on higher levels of the stem, however, they develop, first small indentations, then large, but all this articulation is finally lost as the stem approaches the calyx, just below which the stem foliage is very much simplified (except in C), preparing, as it were, for the very simple sepals of the calyx (the transition from foliage-leaf to sepal is very small in A — the last leaf of which has nearly the form of the sepal — but is rather abrupt in C, which plant has not simplified its stem foliage to the same extent). The Linnaean classification of the plant species does not mention pinnateness, for it is probably never reached. The leaves are 'notched,' and that is all. This might do for the series B, but A seems to go further toward pinnate isolation, and the plant of C approaches this limit very closely.

If we 'read' the series left to right (or vice-versa) we seem to see a 'movement' of the forms one into another. Making up our terminology from appearances, we might speak of a 'tendency' of the plant to 'expand' or 'contract' its leaf, to develop notching or to lose it, during its production of stem foliage. We are not forced to go beyond a 'tendency' to 'deepen' notches, since the plants always abandon this tendency before they reach pinnateness, and thus the latter quality need not be named. Or should it? If we 'read' the series from left to right, perhaps we need not bring pinnateness to the mind. But what about the comparison of plants, 'reading' top to bottom, BAC? Selecting those leaves to the left and right of the vertical line, we find that while the examples of B are only notched, those of A are proportionately more so and those of C so much more so that the protrusions of leaf tissue on either side look somewhat independent. We have here a tendency, not within an individual plant but within the species, to approach pinnateness (since that distance a development is taken in an individual plant is obviously surpassable in another plant). But whatever is in the species as a whole is in every individual as a potential. What should, therefore, be said of this group? The possibility now arises that even the field identification of the plant could be falsified by the Linnaean terminology, given that the person attempting to make an identification had never seen the plant before and had been unlucky enough to come upon an individual with a more pronounced 'pinnate tendency' than even that of C. Of course, anyone who <u>knew</u> the species would never make a mistake, but such a person does not need the Linnaean description to recognize it. I have not had to remember such rules as "three leaves, shiny, sometimes redish" in order to recognize either poison ivy or poison oak since I was fifteen. Once we understand what is characteristic of a plant species, we 'throw away' the rules for "mosaic" or additive descriptions.

These problems do not bother the man who desires only to 'make do' until he has recognized the plants he desires to know. But for one who is attempting, by his classification, to understand something of the plants classified, they are very real. Thus, Goethe:

> The problem of designating the genera with certainty, and of arranging the species under them, seemed insoluable to me. Of course, I read the method prescribed, but how could I hope to find a suitable classification when even in Linné's time genera a species had been shattered and separated, and classes themselves dissolved? The conclusion to be derived from all this seemed to be that even this highly astute man of genius had been able to subjugate Nature only in a general way. My admiration for him was not the least reduced through this; nevertheless, a very special conflict was bound to arise. The reader can imagine my embarrassing situation, a self-taught tyro torturing himself and fighting his way through.[3]

That which is truly characteristic of plant life, that by which we recognize familiar species (undaunted by all the internal 'movement'), cannot be constructed from the Linnaean pieces. No wonder that others were continually breaking down Linnaean classifications — they were, after all, but a mechanical aid to recognition, automatically discarded when characteristic recognition was gained. Such descriptions of plants are similar (although somewhat more apt to their object) to directions for recognizing Rembrandt paintings by general color scheme, or

Mozart piano by a 'light touch' and a list of favored intervals. Seeing even one Rembrandt or listening to even one Mozart is worth a good deal more than any such directions.

Artists, even far less poetic men than Goethe, have often complained of the sort of 'cutting-up' which is performed by analytic thought when attempting to classify something essentially alive. The reader may remember the satire on this procedure in Dickens' Hard Times — the scene is an English class-room, the first speaker is Gradgrind, the instructor:

> "What is your father?"
> "He belongs to the horse-riding, if you please sir."
> Mr. Gradgrind frowned, and waved off the objectionable calling with his hand.
> "We don't want to know anything about that here. You mustn't tell us about that here. Your father breaks horses, don't he?"
> "If you please sir, when they can get any to break, they do break horses in the ring sir."
> "You mustn't tell us about the ring here. Very well then. Describe your father as a horsebreaker. He doctors sick horses I dare say?"
> "Oh yes sir."
> "Very well then. He is a veterinary surgeon, a farrier, and horsebreaker. Give me your definition of a horse."
> (Sissy Jupe thrown into the greatest alarm by this demand.)
> "Girl number twenty unable to define a horse!" said Mr. Gradgrind, for the benefit of all the little pitchers.
> "Girl number twenty possessed of no facts, in reference to one of the commonest of animals! Some boy's definition of a horse...
> "Bitzer," said Thomas Gradgrind. Your definition of a horse."
> "Quadruped. Graminivorous, Forty teeth, namely, twenty-four grinders, four eye-teeth, and twelve incisive. Sheds coat in the spring; in marshy countries, sheds hooves too. Hooves hard, but requiring to be shod with iron. Age known by marks in mouth." Thus (and much more) Bitzer.
> "Now girl number twenty," said Mr. Gradgrind.
> "You know what a horse is."[4]

Gradgrind may perhaps be forgiven a mild overstatement. The audience is left wondering, of course, if Bitzer knows what a horse is. The scene is found in Chapter II, appropriately titled: "Murdering the Innocents." But those who are apt to relish the joke most will find it a slightly bitter one, since the problem is still with us. Some affairs are understood so easily by the use of additive definitions that such an approach has become symonomous, for certain minds, with understanding _per se_. We want to apply it everywhere.

As Goethe complains, the trick is not everywhere applicable. This was, the reader will remember, Kant's point as well. (Applicability of this sort of approach is, in a certain sense, a matter of degree, and these degrees are worked out in Hegel's _Encyclopaedia_, part two: _Philosophy of Nature_.) I purposely couched the discussion of leaf-forms above in terms that would be familiar to any student of plants (anyone, that is, who _looks_ at plants a good deal), but this language of 'tendency,' 'movement,' and 'the whole in the part' pulls away from any subject which may be totalled by addition of the parts. We must either get rid of all such dynamic, or at least unfixed, language, or recognize that the subject does not admit to additive description.

In order to reduce this opposition to a simple example, let us consider the three leaves on Plate III. They have been picked in ascending order (1,2,3) from the stem. The lowest leaf has a slightly serrated margin, bearing what might be termed two deep notches near its base; but below these we find two small, leaflet-like protrusions, that seem almost independent. Are they notches? Looking at the higher leaves, we see that these develop very independent leaflets, the approach to complete isolation growing as we travel up the stem. If we see this as a 'movement' and announce a 'tendency,' does this not commit us to calling the base protrusions on the lowest leaf something like 'embryonic pinnates?' What about the notches, or fpr that matter the serrations? Are these manifestations of the same tendency?

Since the leaves are now dry, their shapes do not vary, all articulations of the order are quite fixed. But they were once alive, and these formations had to grow, and were still growing, to some extent, still changing, when I picked them. The marginal shapes, taken as fixed, are physical 'facts,' but they are not applicable to life. Only a corpse is unmoving. But if we allow that the fixed forms are, to a certain degree, illusory, then what shall we say of their progression?

Once the sense of movement is added at all, it transforms the whole plate. We are all familiar with the fact that one must 'add' something to a picture of a 'flow' of some sort of liquid. The picture shows us a static form, but we do not 'see' it that way. When the flow forms of air and water are photographed, for example, by the shadows thrown, we never look at the result as something static, but always view it dynamically. We bring to the picture a 'felt flow' which becomes the overall context for forms which are then, for the 'eye of the mind,' in motion. This is in no way an isolated case. We are continually adding an intentional dynamism to elements that are of themselves physically static. A note in music, for instance, has almost no independent existence. Every note is in a context of 'movement;' it is going somewhere. It is part of a gesture made by a group of individual notes, a falling phrase, a crescendo, a 'marching' cadence. Although we are not usually focally aware of it, this is the manner in which we view living things as well. Common speech gives the situation away. We speak, figuratively, of the branches of a tree 'spreading,' the grass 'sprouting,' the shoot 'branching,' the 'spray' of small flowers, etc; all in the verb sense, all 'gestures.' We gain the same sense of 'gesture' in the 'movement' of leaf-progressions (Plates II and III). And due to the enormous variation of form and coloration, even within a species, the sense of a characteristic 'movement' within a species probably helps a good deal more in the actual familiar recognition of plants than Linnaean classification ever did. But all this is to argue that the forms of the leaf-margins on Plate III are, to the degree that they are seen and defined as fixed, quite illusory. If we go this way, it is obvious that the language of 'tendency' and 'movement,' figurative as it is, must be taken seriously, and leaf-forms looked at within its context.

This is indeed the direction Goethe took, looking, like Plato, for the 'joint' in Nature, and warning that we must take care to distinguish whether we have actually <u>found</u> such a joint or simply made one.

> I...felt justified in concluding that Linné and his successors had proceeded like legislators, less concerned with what is than with what should be, giving no consideration to the nature and requirements of individual citizens, but intent rather upon solving the difficult problem of how so many unruly, inherently unfettered beings can be made to exist side by side with a degree of harmony.[5]

Once the Linnaean framework had been removed, however, one must begin over again from practically nothing. The 'facts' are no longer there for cataloguing, for what were such 'facts' but the 'notch,' the pinnate leaflet, the smooth margin, and so on, elements which, in Linnaean terminology, must be accepted as atomistic entities, but which, upon closer examination, seem to fade into each other and lose their independence. Many years after the publication of the Metamorphosis of Plants a younger morphologist wrote to Goethe:

> in botany metamorphosis threatens to revolutionize the whole terminology and, as a result, the determining of species...the weak are then fearful because they do not know where such a thing may lead.[6]

So great was the difficulty that others had with his text that Goethe, in 1817, decided to write an introduction to his botanical writings which would assist his readers in grasping his intentions and understanding the difference between his approach and that of previous botanists. The piece was titled Formation and Transformation (Bilding und Umbildung) and its second section, "The Intention Introduced," will be of assistance to us here. The first third follows:

The Intention Introduced

> If we become attentive to natural objects, particularly living ones, in such a manner as to desire to achieve an insight into the context of their essence and activity, we believe ourselves best able to come to such a comprehension through a division of the parts, and this method is suitable to take us very far. With but a word one may remind the friends of science of what chemistry and anatomy have contributed to an intensive and extensive view of Nature.
>
> But these analytical efforts, continued indefinitely, produce many disadvantages. The living may indeed be separated into its elements, but one cannot put these back together and revive them. This is true even of inorganic bodies, not to mention organic ones.
>
> For this reason, the urge to cognize living forms as such, to grasp their outwardly visible and tangible parts contextually, to take them as intimations of that which is inward, and so master, to some degree, the whole in an intuition, has always arisen in men of science. How closely this scientific demand is tied to the artistic and imitative impulses need not be worked out in detail.
>
> One finds, therefore, numerous attempts in the course of art, learning, and science, to found and develop a study which we may call morphology. The varied forms in which these attempts appear will be discussed in the historical section.
>
> The German has the word _Gestalt_ for the complex of existence of an actual being. He abstracts with this expression, from the moving, and assumes a congruous whole to be determined, completed, and fixed in its character.
>
> But if we consider _Gestalts_ generally, especially organic ones, we find that independence, rest, or termination nowhere appear, but everything fluctuates rather in continuous motion. Our speech is accustomed to use, therefore, the word _Bildung_ appertaining to both what has been brought forth and the process of bringing-forth.
>
> If we would introduce a morphology, we ought not to speak of the _Gestalt_, or if we do use the word, should think thereby only of an abstraction — a notion of something held fast in experience but for an instant.

> What has been formed is immediately transformed again, and if we would succeed, to some degree, to a living view of Nature, we must attempt to remain as active and as plastic as the example she sets for us.[7]

It is, the, the Bildung rather than the Gestalt which shall be the target of Goethe's work, a concept which presents some difficulty. If a Gestalt is, let us say for example, a leaf-shape when looked upon as fixed, a Bildung becomes, by negation of the fixed aspect, the form in motion. Yet how are we to imagine these 'forms in motion,' and how develop a taxonomy of something which presents enormous problems just to find at all? As Goethe's acquaintance indicated, the entities of the older terminology (a Gestalt terminology) disappear, everything seems to melt, and firm boundries are nowhere found. One gets a sense of impending anarchy, an inability to grasp anything definite, which causes the "weak" to abandon the search quite early and return to the relatively secure ground of Linnaean botany.

The best way to learn swimming is to enter the water. The best approach to Goethe's ideas would seem to be the text itself, although he thought it readable only by those of some botanical accomplishments. His reservation is probably due to the lack of illustrations in the original. There were a few color plates, but these illustrated only oddities. Goethe depended upon his reader's familiarity with any of the normal formations mentioned. With the help of a number of pages of botanical drawings however, I see no reason why the amateur cannot make a reasonable attempt. Such illustrations do not show everything necessary, however, for close reading, and I have been very interpretive in places to fill in the possible gaps. The reader who mistrusts my commentary may take the original text in hand and spend some days at the botanical gardens, as I did. Certainly this method of reading is the only one which could be fully adequate to the ideas presented, for morphological ideas must be 'seen' to be understood and a good deal of such 'seeing' is necessary for the beginner.

(b) Metamorphosis: Goethe's text

The short treatise that Goethe produced as a result of his sojourn in the south was first published in 1790 bearing the title: Versuch die Metamorphose der Pflanzen zu erklären, but later editions shorted this to Die Metamorphose der Pflanzen, and this is the usual reference. The work begins with a quotation from Linnaeus which reads:

> I am indeed not unaware that this path is obscured by clouds, which will pass over from time to time. Yet these clouds will easily be dispersed when it is possible to make the fullest use of the light of experience. For Nature always resembles herself, although she often seems to us, on account of the inevitable deficiency of our observations, to disagree with herself.[8]

After this warning from the master, Goethe begins his own discussion, couched in the form of numbered aphorisms. His introduction consists of nine of these, and with the exception of the last (an explanation of future intentions) we may benefit from a complete reading.

Introduction

1
Anyone who pays a little attention to the growth of plants will readily observe that certain of their external members are sometimes transformed, so that they assume — either wholly or in some lesser degree — the form of the members nearest in the series.

2
Thus, for example, the usual process by which a single flower becomes double, is that, instead of filaments and anthers, petals are developed; these either show a complete resemblance in form or colour to the other leaves of the corolla, or they still carry some visible traces of their origin.

3
If we note that it is in this way possible for the plant to take a step backwards and thus to reverse the order of growth, we shall obtain so much the more insight into Nature's regular procedure; and we shall make the acquaintance of the laws of transmutation, according to which she produces one part from another, and sets before us the most varied forms through modification of a single organ.

4
The underlying kinship of the various external members of the plant, such as the leaves, calyx, corolla, and stamens, which develop after one another, and, as it were, from one another, has long been recognized by naturalists in a general way; it has indeed received special attention, and the process, by which one and the same organ presents itself to our eyes under protean forms, has been called the <u>Metamorphosis of Plants</u>.

5
This metamorphosis displays itself in three modes: <u>normal</u>, <u>abnormal</u>, and <u>fortuitous</u>.

6
<u>Normal</u> metamorphosis may also be called <u>progressive</u>: for it is that which may be perceived always working step by step from the first seed leaves to the final development of the fruit. Through the change of one form into another, it passes by an ascent — ladder-like in the mind's eye — to that goal of Nature, sexual reproduction. It is this progression which I have studied attentively for a number of years, and which I shall attempt to

elucidate in the present essay. This being our standpoint, we will consider the plant, in the following demonstration, only insofar as it is an annual, and passes by continuous progression from the seed up to the fructification.

7

We may give the name of retrograde metamorphosis to that which is abnormal. As in the normal course, Nature hastens forward to her great end, so in the abnormal, she takes one or more steps backwards. As she there, with irresistible impulse and the full exertion of her might, fashions the flowers and prepares them for the works of love; so here she slackens, as it were, and leaves her creation before it reaches its goal, in an undetermined and powerless condition. Though in this state it is often agreeable to our eyes, in its true inwardness it is feeble and ineffectual. From our acquaintance with this abnormal metamorphosis, we are enabled to unveil the secrets that normal metamorphosis conceals from us, and to see distinctly what, from the regular course of development, we can only infer. And it is by this procedure that we hope to achieve most surely the end which we have in view.

8

We will, on the other hand, avert our eyes from the third kind of metamorphosis, which comes about contingently, as a result of external causes, especially through the action of insects; for this phenomenon might frustrate our purpose by diverting us from the direct path which we ought to follow. Perhaps there will be an opportunity to speak elsewhere of these excrescences, which, though monstrous, are still subject to definite limitations.

I will now attempt to summarize the text, with the hope that a close reading may be substituted, for the purposes of this discussion, for an actual study of the phenomena. I ask the reader to remember that, where Goethe would have presented a number of examples with minimum commentary, developing his themes through the reader's own experience (the text was aimed at those who had some expertise in the field), I must present these same themes with a minimum of illustrations and therefore, I am afraid, a maximum of commentary.

Goethe begins his examination with the so-called "seed-leaves" or cotyledons. Now to call these appendages "leaves" is already, to some minds, to assume a thesis. Goethe is never able to justify, philosophically, his use of suggestive terminology. He often attempts to strengthen his judgment by pointing out that after all, these things are called leaves, as if the name alone had ontological power. But by this Goethe means only to suggest, rather than define; his argument that other organs besides the stem-leaves are termed, at times, leaves, is made to support the contention, not that they should be so defined, but that they must therefore have suggested 'leafness' to the person who named them. Once we are able to look back, however, from the viewpoint reached at the close of his essay, we shall ourselves be able to defend this practice easily enough. Let us ignore, then, all arguments to the effect that the cotyledons or some higher organ of the plant must not be termed 'leaves' and proceed with the author's own terminology.

In Fig. 1, Plate IV, we see an expanded model of the annual plant that is the subject of the treatise. The cotyledons are the lowest appendages on the stem, just above the root. They are actually the two halves of the seed, altered by germination to near-leaf shape. For instance, the common green pea will divide, when its skin is removed, into two similar hemispheres. These contain, between them and at one edge, the point of germination. The stages of germination will proceed by developing an embryo at the point of attachment of the two lobes, putting down a root, and finally raising a shoot. The root growth is nourished from the material within the two hemispherical lobes (and later, the beginning of shoot growth as well). When the shoot is raised, the cover splits off the pea and the two lobes separate. Since their inner content has been somewhat diminished by this time, they tend to flatten out and thus approach recognizable leaf form. Soon after they will turn green if they are not, as in the case of the pea, already so. Most cotyledons manage to carry on the photosynthetic process to some degree.

Fig. 2 presents three stages of germination of the garden bean, showing the development of the first stem leaves (as yet inside the bean). In Fig. 3 we see the horse-bean (Vicia faba) in two early stages, the first showing the new shoot erect and the cover splitting off, and the second the cotyledons spread, paired about the first nodal point of the plant (there is an 'eye' or small bud in each axil). The second and often third of the stem nodes will develop within the seed as part of the first shoot, and therefore a number of nodes will be, to begin with, crowded upon each other. Vertical stem-growth will distance these points from each other, once the shoot begins to unfold upwards, but although many dicotyledonous plants arrange their higher nodes alternately upon the stem (Fig. 1), the first two remain paired, and thus the original crowding is never completely dissolved. The conifers in particular show this tendency to group organs together at the first node, for their seedlings (Fig. 4) produce a whorl of needles for cotyledons, almost as if to form a calyx beneath a flower. (Indeed, the seedling looks like a flower — except in color — for the new shoot sits within this cupping formation.) We shall have reason, Goethe tells us, to remember this point about a grouping tendency when we come to the examination of inflorescence.

From the first nodal point the plant climbs, and spreads, into vigorous activity. The stem leaves, larger and far more elaborately formed than the crude cotyledons, spiral upwards about the stalk or rise in pairs, but may undergo changes of their own. They are, to begin with, an alteration from the simple cotyledons. But as we have already seen (Plates I, II, and III) they may pass through a series of somewhat different forms, which change may be termed serial metamorphosis. This serial alteration will proceed on one of two plans, pinnate or palmate. The former develops leaflets in successive locations on the mid-vein, the latter in a radiation from a common point of connection to the leaf-stem. (Fig. 1-4, Plate V, present a number of variations of leaf-form based on a pinnate plan.)

The series of leaves on Plate VI run from the lowest to the highest on the stem (above the cotyledons and below the calyx), although they are not exhaustive, and only two intermediate forms of the greater number actually present have been included (also arranged according to height). They are of palmate design, radiating from a common point. If we try to characterize the change they undergo as they rise of the stem, we may say that, terming the leaf tissue itself the 'positive space,' and the absence of the same the 'negative,' the ratio between positive and negative spaces within the circle described by the perimeter of the leaf has changed. The lowest leaf bears only a few indentations of negative space, but as we proceed upward the indentation grow deeper, plunging toward the connection point of the veins. The last leaf is still more positive than negative, but the ratio is not overwhelming, as it was in the first leaf.

In order to grasp this directly, we must consider a process which Goethe terms <u>anastomosis</u>; the spreading and re-uniting of the vein branches. Goethe introduces this concept in reference to a leaf in which the veins, having branched apart from each other, are then re-united by coming together at the tip of the leaf. Later in the text however, he speaks of the leaf surface being filled in by <u>anastomosis</u>, evidently applying the term to any cellular connection between the veins. It is in this second and more general process, the growth of inter-connecting tissue between the branches, that I mean to indicate with the term.

The two elements, expansion and connection, may be separated, not only in the mind but in actual growth. So we see that, in the case of the <u>Ranunculus aquaticus</u>, those leaves that grow entirely under the surface of the water develop only the first part of <u>anastomosis</u>, the spread branches of veins.

(Fig. 5, Plate V) When a leaf rises, however, even part way out of the water into air, the tissue growth proceeds to unite the otherwise independent filaments. (Fig. 6, V) Returning to the series of Plate VI, we can see that it falls somewhere between the two extremes shown by the Ranunculus. It is just this position that makes possible the variation, in fact, for the serial change is produced by a greater and greater retardation of connective tissue growth as we move higher on the stem. The more it is held back, the more independent the sections of the leaf become. The 'movement' toward pinnatism on Plates II and III may be understood in the same way.

The progression towards higher articulation of the leaf takes place by retardation of tissue growth, and thus the holding-back of anastomosis (second-half). Serial metamorphosis may proceed in another direction however, beginning with a highly articulate leaf and filling in, as it were, the negative spaces by completion of anastomosis. During this process the leaf may grow smaller or larger in its overall dimensions, giving us a total of four 'movements' or change: expansion, contraction, negative or positive anastomosis.

When we come to relate this change to the rest of the plant, we see that the stem leaves have a number of possibilities in their approach to the calyx. They may not show any variation to speak of, and therefore, fill the stem between cotyledons and calyx with nearly identical leaves, not necessarily resembling either cotyledon or calyx leaf. They may, on the other hand, show a direct relationship with these end points, resembling either cotyledon or calyx leaf or both. As Goethe phrases it, the stem-leaves may approach the calyx by either 'creeping' into it or 'leaping' into it. The aster, Plate VII, is a case of the former, and the leaf-series of Plate VI of the latter (since here the plant must 'leap' from the highly articulated leaf below the calyx to one that is slightly less articulated than the first member of the series). Both cases contain more than one 'movement.' The aster not only contracts, but simplifies through positive anastomosis; the plant of Plate VI expands, and retards anastomosis. One should not conclude, however, that multiple 'movements' are necessary. The plant may just as well reach the calyx by gathering the stem-leaves directly into a calyx below the petals. (Fig. 1, IX) Nature has a great profusion of choices.

Goethe does not develop this matter in great detail, but I think it may be helpful to proliferate examples at this point, that the reader unfamiliar with botany may understand something of the extreme flexibility of the leaf-plan. Many plants produce such an extended series that the individual leaves, if taken out of their context, will not seem to resemble one another enough to be likely candidates for members of the same progression. The first leaf of Plate VIIIA, for example, does not seem related to the second from the top on VIIIB, although they are both from the same series (buttercup, large plant), and when they are put in their respective positions in the series the unity is clear enough. Notice also that this series, while approaching the calyx gradually, 'creeping' into it as it were, does not run directly from largest leaf to smallest but first expands, through several members, and then contracts to the calyx. The progressive retardation of anastomosis is continuous, however, beginning with the point of greatest anastomosis and finishing with the point of least, the triune, smooth-margined leaflets. Of the four means of variation, this plant uses three for the serial metamorphosis of the stem leaves: expansion, contraction, and retardation of anastomosis. The calyx leaves are similar to the last leaflets in the series, smooth-margined, slightly expanded in the middle (approaching the petal), and gathered together at the base. Thus the plant makes an elaborate approach to its goal (three means of variation). The aster on Plate VII came to the same goal (smooth margined calyx leaf) by only two means: contraction and completion of anastomosis, and the second of these the opposite of the route taken by the buttercup. This ability of leaf-plans to be taken in any direction by a multiplicity of means would be a familiar characteristic to the audience that Goethe imagined for his treatise, and the reader must keep it in mind if we are to proceed with a fair reading.

Once we turn to the calyx proper, we find that, as a rule, the leaves or leaflets here are smaller, less articulated (usually smooth-margined), and of finer texture than the stem leaves. In some cases they do not seem at all related to the latter, but if we question the continuity with the stem leaves we may find, with a bit of looking, exemplary case in which we can have no doubts whatsoever. Two of these 'missing pictures' are supplied by the _Eranthis_ and _Nigella_ of Fib. 1, IX. Here the characteristic stem-leaves are gathered into a calyx directly below the petals. The farthest removed from this situation of total continuity between calyx and stem leaves would be the case in which the calyx is formed in one piece, rather than by a gathering of separate or semi-separate leaves. But we can again, with some looking, find the missing elements which will make our display continuous. The primrose, for example, has a one-piece calyx, but upon examination this seems to be formed of several small leaves which have fused at the edges, by anastomosis, into one. From the calcis that are deeply cut, thus hinting origin by anastomosis between several members, to those that are not, is only a movement of positive anastomosis.

Goethe calls the movement of the stem-leaves away from the cotyledons an 'expansion,' and towards the calyx, or better, into it, a 'contraction.' One does not usually see the full potential of this terminology immediately, but a little help may be forthcoming from consideration of the following train of thought. The 'contraction' into the calyx (taking just this 'movement') is sometimes one of spatially smaller leaves, but not always. It is, however, always a contraction of the distance between stem nodes, for a calyx must gather these in one place rather than spread them out as would be the case on the stem. This is the only contraction of actually measurable _size_ (the distance between nodes) that the calyx must contain. But the movement from a highly compound leaf to a simple is also a contraction — it is the movement of many into one. When the calyx gathers the nodes into one point we have already a basic many-into-one movement. After this accomplishment, the same tendency may be continued by anastomosis. Indeed, some plants have already begun this contraction in the stem-leaves (those that 'creep' into the calyx), and from these we may take any number of pointed examples.

Restricting the discussion to one instance (since the reader may find others by his own examination of the previous material on leaf-plans), the rose, we find a movement from a fully pinnate leaf to the much simpler calyx-leaf (Fig. 1, XI) in which the remnants of pinnate development may yet be discerned. Now let us consider: the leaflets of a fully pinnate leaf are quite independent (the rose shows this plainly by affording the pinnate leaflet a good-size stem of its own), yet one may find a movement, from the compound to a simple leaf, expressed in a progression of forms. The individual leaflets, spaced along a central 'mid-vein,' are potentially (by positive anastomosis) one leaf. And what is this picture but a model for the whole stem? Each pinnate leaf is a miniature stem, and therefore each stem a compound leaf. Understanding this, we may see why Goethe speaks of the "contraction" into the calyx. Not only do we witness there a gathering of nodes, but also, in all cases where the stem-leaves are not left untransformed in the calyx but modified, a gathering of many into one. The extreme is the case of the one-piece calyx, in which anastomosis has proceeded to unify all the leaflets of what would be, after all, a type of compound leaf (sprouting from a common gathering of nodal points), into a simple leaf. The plant begins, then, with an expansion away from the seed (but the cotyledons of some plants, by pairing nodes, preserve a 'memory' of this contracted state even after the shoot has grown long and spiraled its nodes widely), but then contracts again, sometimes to a single leaf, in the calyx.

After this, the plant expands again into a corolla of petals. The petals are generally larger than the sepals, and often more numerous, but the most striking difference is the color, texture, and scent. Indeed, these new elements make the corolla of many plants differ so greatly from the calyx or stem-leaves that, on first glance, one finds no continuity at all. When we overcome the one-sidedness of our first impressions, we may see clearly that there is a continuity of structure between the petals and the sepals. The former, are, after all, a development of the nodes gathered within the ring of sepals, and therefore take their origin from a nodal point just as leaves do. They are not impossibly far from leaf structure, at least spatially, and in many cases the movement of the stem-leaves toward the calyx continues in an obvious way to the petals. (The aster is a case in point—Plate VII) Those petals that are at the other end of the spectrum, resembling neither stem or calyx leaves, may yet be understood with the same approach we have utilized in the case of extreme variations of leaf structure. (The petal often reaches very different characteristics than those of the leaves, but a careful analysis will show that, at least structurally, these characteristics are not beyond the reach of the leaf-plan.) Our real problem begins with the consideration of color.

If Nature will not supply us with a continuous row of 'pictures' with which we may find the continuity we seek for in the plant we have before us, we must go elsewhere to find the 'missing pictures.' Not every inflorescence breaks into the progression of the plant without warning. The pink, for example, often develops a second calyx, quite similar to the first, except for the beginning of the flower color at its edges. The tulip does not develop a calyx at all, but follows the stem-leaf phase directly with the petals. Some tulips show a considerable difference between petal and leaf, but other varieties allow these two to approach more closely. Goethe had a color plate made of one of these which, as if to provide what he was looking for, had conveniently forgotten to separate the stem and petal phases completely, and had grown a leaf which served both as stem-leaf and petal, the lower end being attached to the stem but the upper attached again to the nodal gathering of the flower. The top third of this leaf took on the color of the petals, the lower part remained green. Although Goethe did not mention them, we may add the example of those plants which produce, for their only hint of a corolla, a sudden change of color (from deep green to bright rose) in the stem leaves themselves, and even then not throughout the leaf, but only in one part of it. (The change may take place either at the tip of the leaf or at the base.)

As the plant grows taller, says Goethe, it purifies its saps in order to support finer formation. He uses the term 'filtration' to apply to this process, but it should not be interpreted as a mechanical or even chemical hypothesis. The higher an organ grows on the plant stem, the farther the nutrient solution must travel through the plant body to reach it. When the plant reaches a certain height, its leaves contract into a calyx, sacrificing the vegetative power, and then the corolla appears, qualitatively different from the foliage or even calyx leaves, its petals of fine texture, bright color, and scented. This aleration seems to be directly connected to the height of the stem, until we discover that we can bring on the flowering phase early by withholding food, or keep it off, by over-feeding. That which seems to be a function of the height of the stem now turns out to be controlled by the food supply as well. Thus Goethe attempts to express both factors within one relation, with the notion of a 'purification' of the sap, an operation which we suppose to require height of stem in proportion to the unpurified nutrients present in the sap. This is a type of verbal shorthand for the observed relations, but the term 'filtration' is unfortunate, since it suggests a mechanical process. 'Purification' is better, since its meaning is ambiguous.

Within the corolla we find the <u>stamens</u>, <u>nectaries</u>, and <u>pistils</u>, (the <u>corona</u>, which appears in some flowers—such as the daffodil—Goethe takes as a type of nectary.) all three organs forms of contraction.

The stamen may be divided into upper and lower sections, the pollen-bearing <u>anther</u> and the stem-like <u>filament</u>, respectively. The close relation of the stamen to the petal may be seen through the stamens of the <u>Canna</u> (Fig. 2, IX), which are nothing more than anther developments on the petal-edges. Such development may cause a corresponding loss of the power of anastomosis (taken as the power of expansion), and the petals showing it may contract in proportion to the amount of anther formation (Fig. 3, IX). When this contraction is complete, the result is a filament, an appendage which bears a direct relation to the leaf stem (particularly in its character as mid-vein), in that it is a stalk-like structure that has yet a potential for anastomosis, i.e. for expansion into a petal, since the transformation from petal to stamen is reversible. (The doubled rose, for example, presents petals where stamens would normally be, and is, if completely doubled, sterile as a result.)

The nectary may be understood as an intermediate form between the petal and stamen which has its own stability and function. When it is closer to the petals, as in the <u>Pentapetes</u> (Fig. 4, IX), it appears as petal-like forms that seem to have been arrested at the half-way point of contraction between the petals and the stamens (the alternate with the latter). In the <u>Kiggellaria</u> the nectary is formed as a basal scale on the petal itself, retaining a shape somewhat related to the petal but already showing the articulations at the top which could become, if the transformation went forward, the lobes of the anther. At the other pole, where the relation to the stamen is more obvious, we find the nectaries of the Parnassia, (Fig. 5, IX), which affords us intermediate forms between nectary and stamen (Fig. 1, X). The nectaries of the crowfoot plants (Fig. 2, X) run from simple, petal-forms (II) through horn-like containers (I, IV) to forms which seem to have little to do with either petal or stamen, the Aconitum and the Nigella (VI and V). Even the cup-like forms are still petal-like in character, but these last two plants do seem to have departed from anything recognizable. Yet close study may detect (according to Goethe) a relation between the shape of the unusual flowers of the Aconitums and their corresponding nectary formations (Fig. 3, X). Turning to the Nigella, we may detect the same continuity by other means, for these oddly-shaped nectaries, which seem to have departed totally from petals, are yet replaced, in a doubled flower, by petals. Thus even those forms which look to be very far removed from the rest of the flower are still traceable, when we look to the proper quarter, to an affinity with the petal or stamen formation processes.

The pistil consists, in its most expanded form, of the stigma (the surface which receives the pollen), the style (the support of the stigma), and the carpel (container of the ovules at the base of the style). Goethe's discussion at this point treats the formation of the style, without mention of the carpel (and including, of course, the stigma as part of the style). This latter organ is examined, at a later point, as a seed-case, but I think we do but aid his argument if we treat it now as well.

Again we must take up the theme of contraction, for the reproductive organs, when they move away from the petal, do so by this gesture. At one end of the spectrum, when the contraction is mild, we find the style of the Iris (Figs. 4, 5, X), which is not far removed from the neighboring petals. At the other extreme we have the style of the Crocus, (6, X), which may remind us of the major veins of a leaf which has no interconnecting tissue growth. We may watch the contraction, in an imaginative manner, by considering the three forms of Fig. 2, XI. Beginning with (c) and moving to (a), we see a foliage leaf (on a stem which has grown through the flower), an intermediate form, and the style of a rose. (Since the style of the rose is covered with small hairs, the affinity with the leaf, which has begun to show a few hairs at its base, is more easily traced.)

This sense of contraction may remind us of the formation of the stamens, and indeed the same relations seem to be present. Both are related, by contraction (or expansion when going the other way), to the petal, and the forms most distant from the latter are filament-like in both cases. Since both take their origin in a retardation of anastomosis, we might expect to find some transition forms between style and stamen, and we may do so in the rose. A series of forms is shown in Fig. 3, XI, which includes several intermediate stages, many combining both anther and stigma. Like the stamen, the style may be lost through doubling of the flower, and in the case of the <u>Ranunculus</u> <u>asiaticus</u> shown in Fig. 1, XII, petals have replaced the styles completely.

We may, in this consideration of the pistil, include the carpel, for indeed that organ is included in a number of the forms shown in Fig, 3, XI. Again, the series of forms of Fig. 4, XI presents the petal, pistil, and the intermediate structures of the peony, showing the formation of the carpel quite clearly. The entire pistil, it would seem is continuous with both petal and stamen, as a contraction of the former and a sister-form of the latter, and therefore, like the stamen and the nectaries, represents a contraction from the corolla phase.

Goethe turns next to the seed-cases (carpels after fertilization) and, in order to meet the new situation, i.e. the production of seed, begins by discussion of fertility. The leaf itself, he points out, gives us ample evidence of its fruitfulness. The linden tree produces a blossom directly from the mid-vein of its leaf (Fig. 2, XII).. The Butcher's Broom does likewise, but here the blossom is not projected outward by its own stem but is nestled in the cup of the leaf which acts as a calyx. The fern, of course, bears spores directly on the undersurface of its leaf without a stage of inflorescence. (Figs.3 and 4, XII) The leaf can be seen then, to bear a direct relationship to the seed, and with this in mind we need not be surprised if the plant should modify its leaf in order to give the seed greater protection than the fern gives its spores.

Attempting this line of 'seeing,' we may think of the legume seed vessels (such as the pea-pod) as folded leaves, fused at the edges. (Fig. 1, XIII) If we imagine several of these gathered about a common center, we have a plan for more complex capsules, such as that of the Nigella (Fig. 2, XIII), or the marsh marigold (Fig. 3, XIII). It is only a step from here to the construction of the seed-case of the peony, which may be imagined to have fused a number of pods about its center so completely that neighboring walls have become one. (Fig. 4, XIII). And now, while we are thinking in this wise, we should remember the movement of the peony from petal to pistil in Fig. 4, XI, which suggests that the carpel is formed by rolling the petal and fusing the seam. (The mechanical processes involved in any of these transformations, of course, are not our concern, and such terms as 'folding' or 'rolling' are utilized only to describe the results of such an action, not in order to suggest the action itself.) In this manner we may come to recognize the continuity between the seed-case and the general organ of the plant, the leaf.

After fertilization the carpel generally grows a good deal larger to accomodate the seed, and Goethe terms the seed-case a phase of expansion. Whether he would put the carpel before fertilization into the same category I cannot decide. If one uses his categories however, I think it probably correct to call the pistil formation as a whole a contraction, remembering that by this we mean the formation of the style and its base. Complex seed-containers are a fusion of several bases, and thus several pistils. The 'expansion' is that of the whole, while the 'contraction' that of the part. The pistil, as a unit, finishes its formation at fertilization. After this point we trace the development of a different unit, the seed-case. This organ, whether simple or compound, usually undergoes a noticeable expansion after fertilization.

The seed itself, of course, must be considered a contraction, indeed, the most extreme phase of contraction possible. Carried along, as it were, by this movement of contraction are the immediate leaf-like envelopes of the seed. In a number of trees this envelope takes on the form of small wings (Figs. 5,6, XIII), leaves that are not exactly fitted to the seed. The maple and elm produce a comparatively large wing, but the ash a smaller one (Fig. 1, XIV), and the birch the very miniscule projections on each side of the seed (Fig. 2, XIV). It seems almost as if the power of the contraction grew larger as the wings grew smaller, and of course those seeds which do not spread their covering sheath into wings may be imagined to complete the series, having formed the envelope exactly to themselves. These stages of contraction can be seen in the successive sheaths of a single plant, the marigold (Fig. 3, XIV). Here the outermost forms are the 'leaves' of a small calyx, resembling the calyx of the flowers except for the greater curvature of the 'leaves.' When these appendages are examined, they show the formation of a rudimentary seed on the mid-vein, and the curve of the form begins an encircling gesture. The next ring of forms has lost most of its resemblance to the leaves of the plant. It is much contracted, beginning to show hair-like growth, more curved, and bearing a more developed seed (but still usually infertile) in the cup of the curve. The final forms are more strongly curved yet, their coats are fully fitted to the interior seed (now fertile), and the hair-like growth extends about the whole of the outer curve. Even as the petal seemed to contract proportionate to its development of anthers (Fig. 3, IX), so here the membrane seems to contract according to the development of the seed within it.

Goethe adds to this discussion a "Recapitulation and Transition" which allows him to move to questions which should accompany the examination of the cycle he has traced even if they are not part of that cycle. The first of these is the most important for us: the nature of the bud. Every node has the power to bring forth one or more buds, and each of these may be compared to a germinating seed. It may be grafted to another plant, it may, if conditions are right, put down its own root. It is, of course, the beginning of a new shoot. The bud, unlike the seed, needs no cotyledons, for it is still fed by the mother plant. It consists of nodes and leaves, and each of the nodes will be able, at a later time, to develop buds of its own. (Here the relation to germination seed is very direct, for the 'compressed plant' may be seen in the structures of the bud.) In highly organized plants, the buds and seeds are kept quite distinct, but as we move to lower levels they seem to merge. We may find, if we understand the origins, indubitable seeds and indubitable gemmae (asexually produced cell groups capable of generating a whole plant), but once these have separated from the mother plant the distinction becomes purely historical, since the seeds and gemmae are alike to the senses. Seeds, therefore, are distinguished from the buds of higher plants by their enclosed condition (and their food supply), and from the gemmae, which seem to be something like buds on the lower plant, by the nature of their formation and detachment, but are obviously closely related to both. (The nodal point itself cannot, however, be likened to a seed, but only to the nodal point within the seed, and is without visible structure. Morphology must either treat the node as a limit for its approach or begin microscopic analysis.)

Goethe continues from here with an explanation of collective inflorescence, which we shall pass over, and two discussions of oddities, namely, a treatment of a proliferated rose and one of a proliferated pink. These are worth a brief review.

The rose in question has grown through its flower, producing, in the center of the corolla, not stamens and pistils but a stem which continues its growth above the flowering stage. The stem shows traces of red above the corolla, and has carried upwards with its growth several red petals, the last of these being half-red and half-green. Finally true stem leaves and buds appear, although the buds are imperfect. No true calyx has formed beneath the corolla, but a number of stem leaves are gathered into relatively close proximity there. Although a partial contraction is present here (or the corolla could not be formed), it is obvious that the full growth inhibition that is needed to form a fertile inflorescence was never reached. A hint of its lack may already be found in the absence of a true calyx, but the full effect is not discovered until we view the flower from above and see that neither stamen, pistil, nor seed-container were ever formed, but instead the vegetative power of the plant reasserted itself in the further growth of stem.

The proliferated pink does produce a nearly complete flower, but its seed-capsule is imperfect. (Fig. 4, XIV) Between petals and carpel small stems bearing new flowers have developed. (And one stalk rises from the carpel itself.) The proliferated rose paused long enough to develop a corolla, but then continued its stem growth. The pink has actually developed, if we do not include fertilized seeds, the complete flower, and yet has brought new stems from some of its clustered nodes. In each case, we see that the plant must have had, potentially, the possibility of further progression, but would normally sacrifice the potential and put an end to its growth in order to reach the formation of seeds.

Passing over one further section, a short discussion of the Linnaean doctrine of "Anticipation," I shall give the summary in its entirety.

Summary

112

I hope that the present attempt to interpret the metamorphosis of plants may contribute something to the solution of this enigma, and may give occasion for additional investigations and deductions. The scattered observations on which it is based have already been collected and arranged in order; and it will soon be decided whether the step which we have here taken constitutes an approach to the truth. We will now, as shortly as possible, summarise the principal results of the foregoing discouse.

113

If we consider a plant in so far as it expresses its life force, we see that this force reveals itself in two directions— first, in *vegetative growth*, when it produces stem and leaves, and then in *reproduction*, which is completed in flower - and fruit - formation. If we inspect growth more closely, we see that, since the plant carries forward its existence from node to node and from leaf to leaf as it vegetates, a reproduction may be said to take place. This type of generation distinguishes itself, by the fact that it is *successive*, from the reproduction through the flower and fruit, which happens *suddenly*; being successive, it shows itself in a sequence of individual developments. This vegetative force, gradually expressing itself, bears an extremely close relation to that which manifests itself once and for all in a conspicuous reproduction phase. A plant can be compelled, under various conditions, to *vegetate continuously*, while, on the other hand, one can *hasten the flowering phase*. The former result occurs when crude saps flood the plant; the latter when more rarefied forces predominate.

114

When in this way we have named the *vegetative shoots* as representing successive reproduction, and *flower and fructification* as representing simultaneous reproduction, we have, in so doing, indicated the manner in which they both express themselves. A plant which vegetates, spreads itself more or less, and develops a stalk or stem;

the intervals from node to node are generally noticeable; and its leaves spread out from the stem on all sides. On the other hand, a plant which flowers has contracted all its parts; increase in breadth and height is, as it were, arrested; and all its organs are in a highly condensed state and developed in close proximity to one another.

115

When now the plant vegetates, blooms or fructifies, so it is still the same organs which, with different destinies and under protean shapes, fulfil the part prescribed by Nature. The same organ which on the stem expands itself as leaf, and assumes a great variety of forms, then contracts in the calyx— expands then again in the corolla — contracts in the reproductive organs— and for the last time expands in the fruit.

116

This operation of Nature is at the same time bound up with another— the assembling of different organs round a centre, according to definite numbers and proportions, which, however, in many flowers may often be, under certain circumstances, much modified and variously changed.

117

In like manner in the formation of flowers and fruit an anastomosis operates, whereby the extremely delicate fructification parts, closely crowded against one another, are most intimately united, either throughout their whole duration, or only for part of this time.

118

These phenomena of approximation, arrangement round a centre, and anastomosis, are not, however, peculiar to flowers and fructifications. We may, indeed, perceive something similar in cotyledons; and other plant members will give us ample material for similar considerations in the sequel.

119

Just as we have now sought to explain the protean organs of the vegetating and flowering plant all from a single organ, the leaf, which commonly unfolds itself at each node; so we have also attempted to refer to leaf-from those fruits which closely cover their seeds.

120

It goes without saying that we must have a general term to indicate this variously metamorphosed organ, and to use in comparing the manifestations of its form; we have hence adapted the word leaf. But when we use this term, it must be with the reservation that we accustom ourselves to relate the phenomena to one another in both directions. For we can just as well say that a stamen is a contracted petal, as we can say of a petal that it is a stamen in a state of expansion. And we can just as well say that a sepal is a contracted stem-leaf, approaching a certain degree of refinement, as that a stem-leaf is a sepal, expanded through the intrusion of cruder saps.

121

In the same way it may be said of the stem that it is an expanded flowering and fruiting phase, just as we have predicated of the latter that it is a contracted stem.

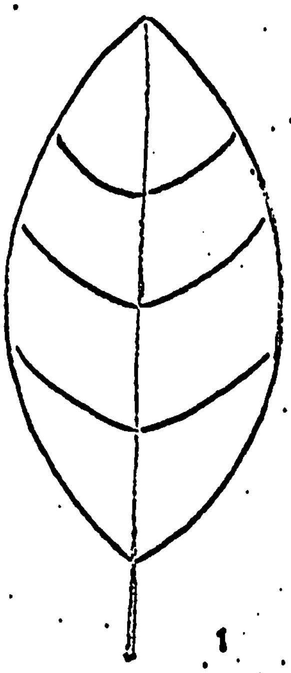
122

I have moreover at the conclusion of this essay considered the development of buds, and through them have sought to explain compound flowers and unenclosed fruits.

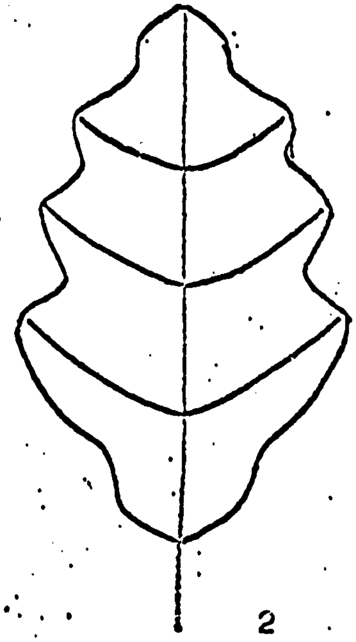
123

And in this way I have labored to expound, as clearly and completely as I could, an idea which in my eyes has much that is convincing. If, in spite of all, it is still not fully in accordance with the evidence; if fault may still be found with it for some inconsistencies; and if the foregoing manner of interpretation does not seem to be universally applicable: so much the more will it be my duty to note all objections, and to treat this subject more exactly and circumstantially in the sequel, in order to make this way of looking at things more lucid, and to earn for it a more general approval than it can perhaps expect today.

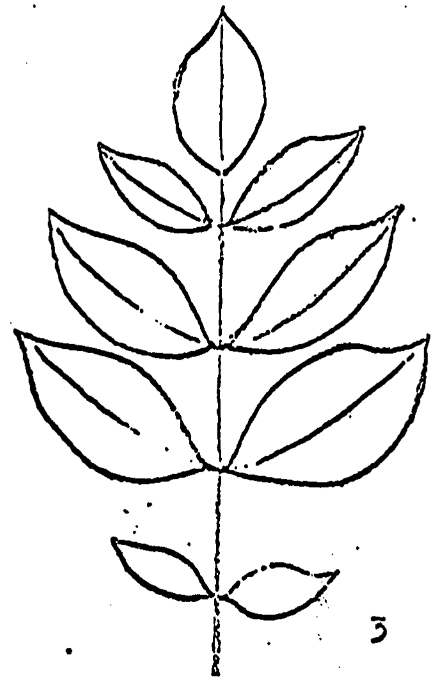
I



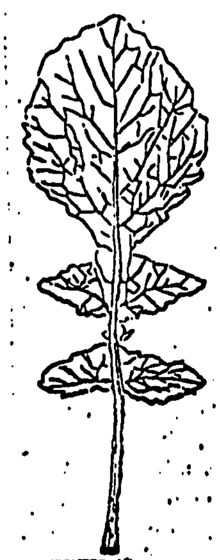
1



2

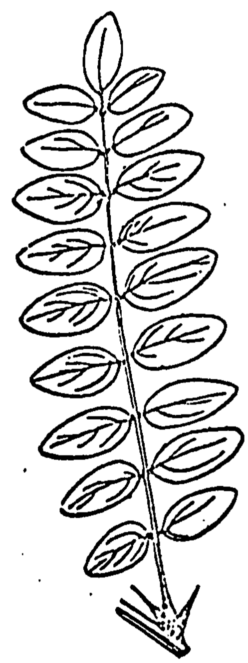


3

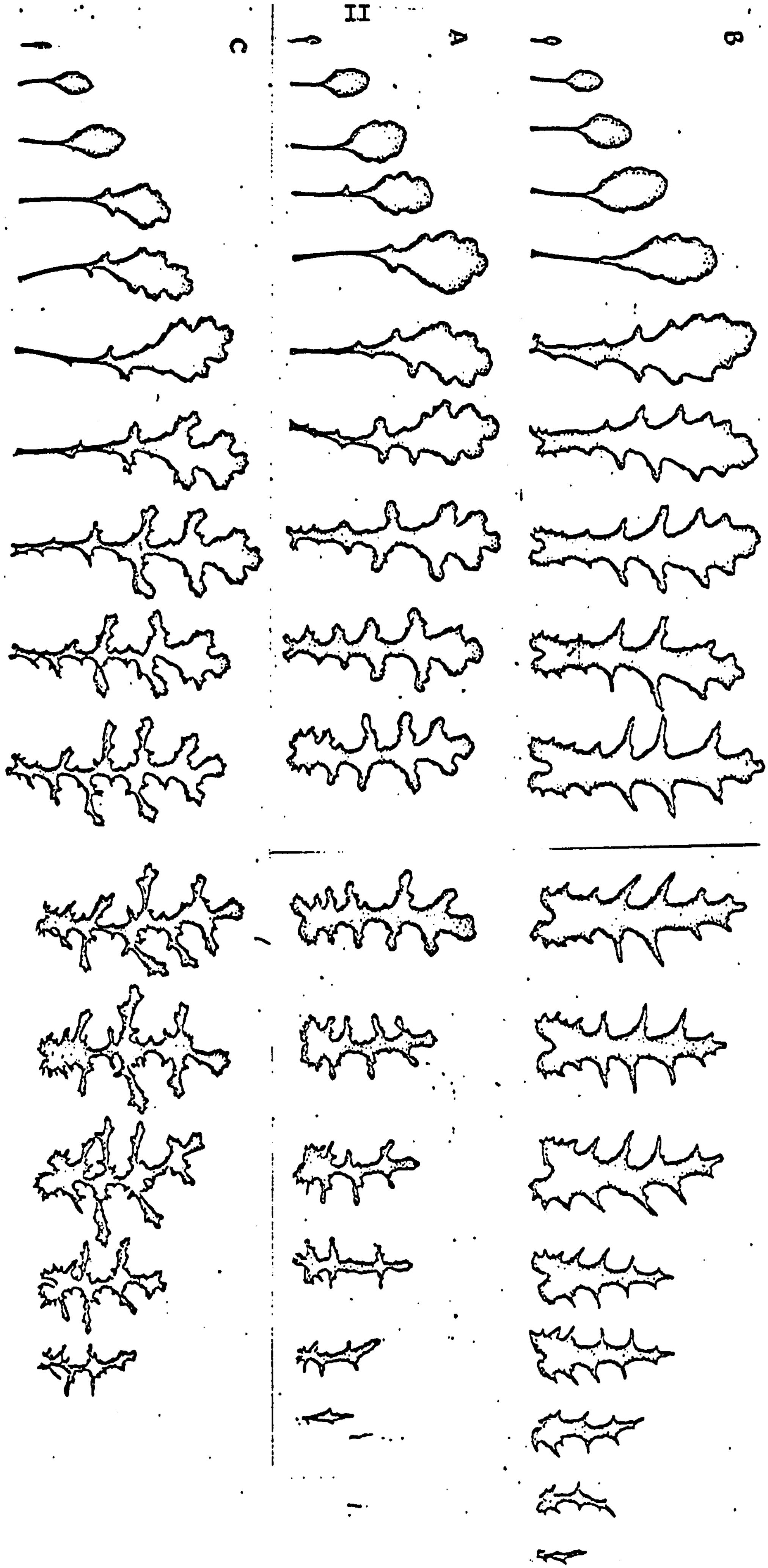


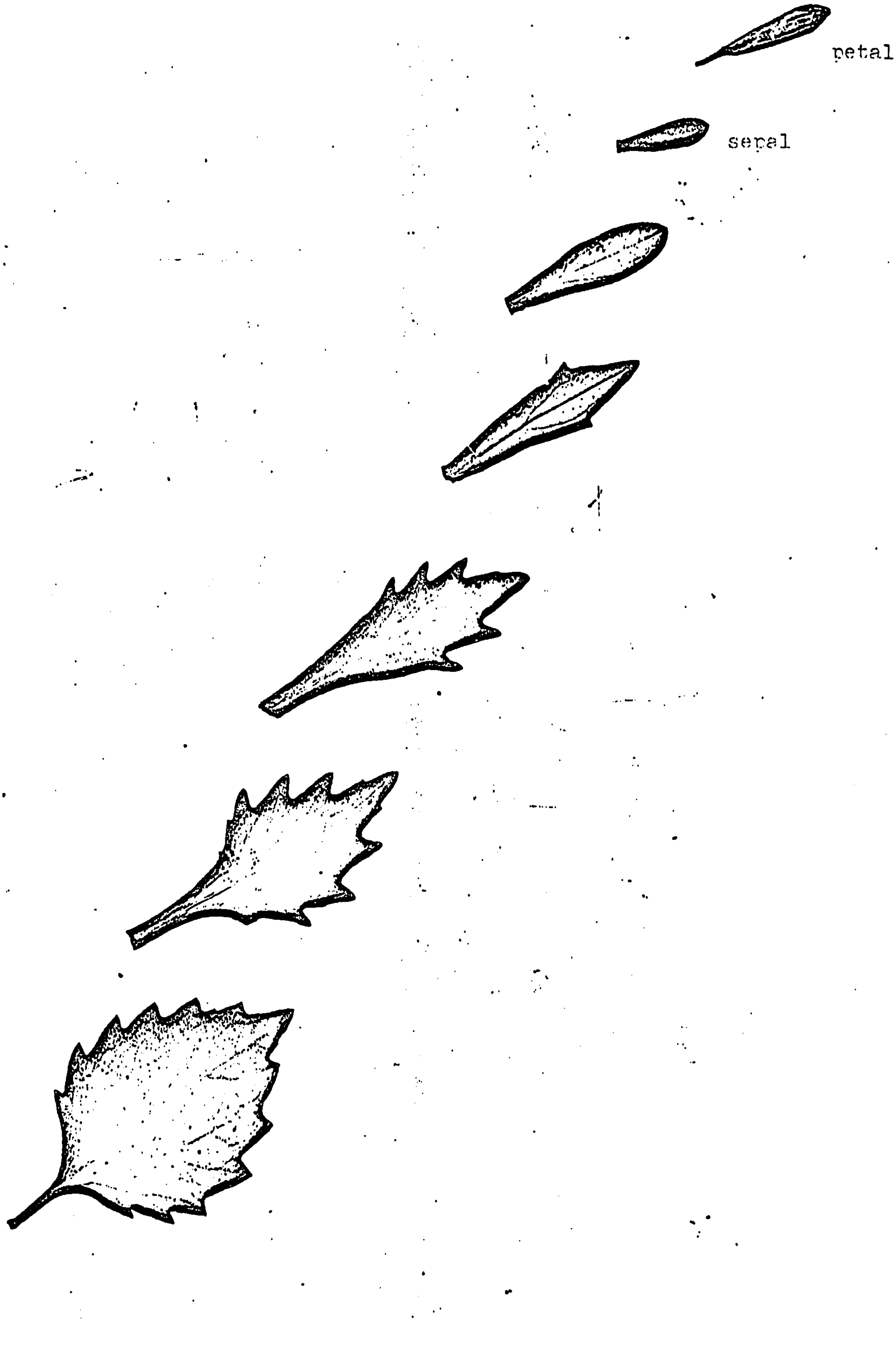
4

5



6


II
C
A
B


petal
sepal

IX

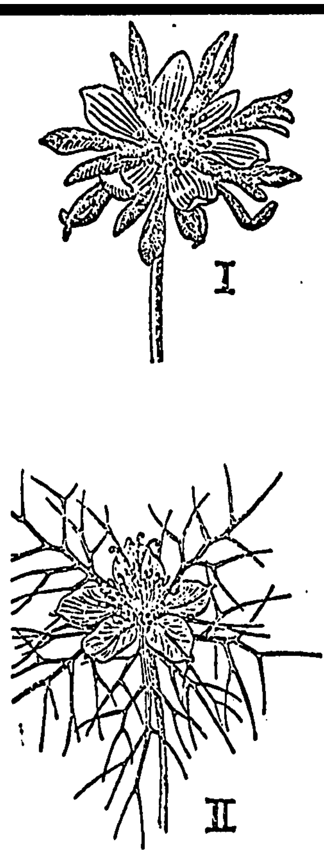


FIGURE 1

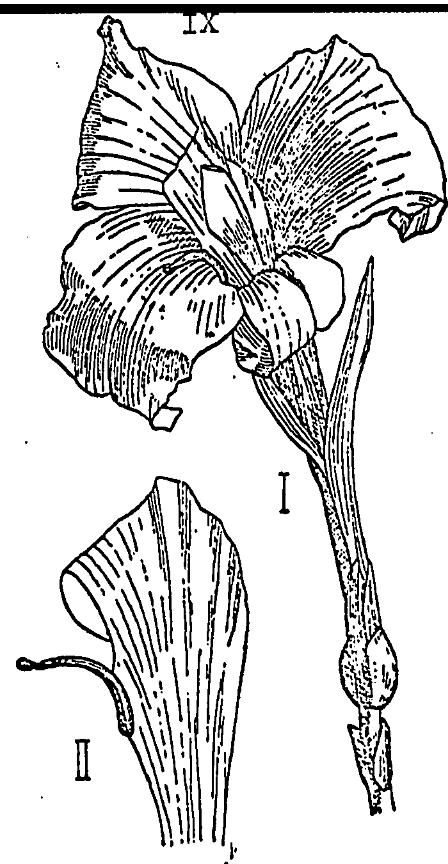


FIGURE 2

FIG. 1 —"Stem leaves . . . drawn together into a kind of calyx directly below the corolla." I. *Eranthis hiemalis.* II. *Nigella damascena* (after Schönichen). FIG. 2 —*Canna iridiflora.* I. Complete view of flower. II. Individual petal with anther, the petal assuming the role of filament.

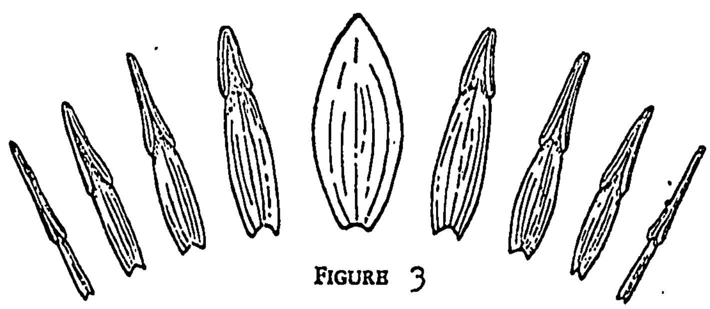


FIGURE 3

Successive transformation of petal into stamen, in white water lily, *Nymphaea alba.*

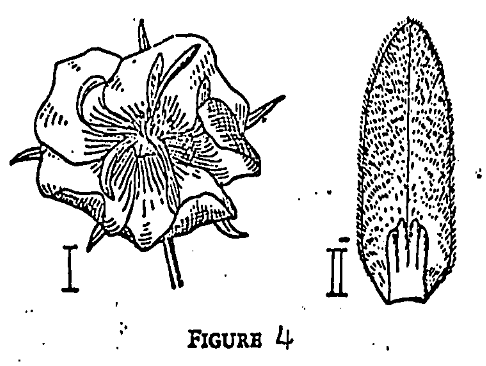


FIGURE 4

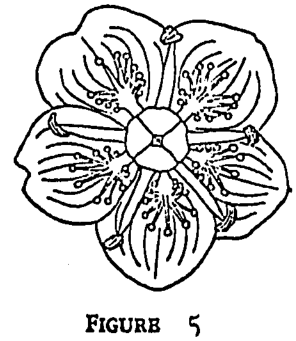


FIGURE 5

FIG. 4 -I. Flower of *Pentapetes phoenica.* II. Petal of *Kiggellaria africana* with basal scale. FIG. 5 -Flower of *Parnassia,* showing nectaries between stamens.

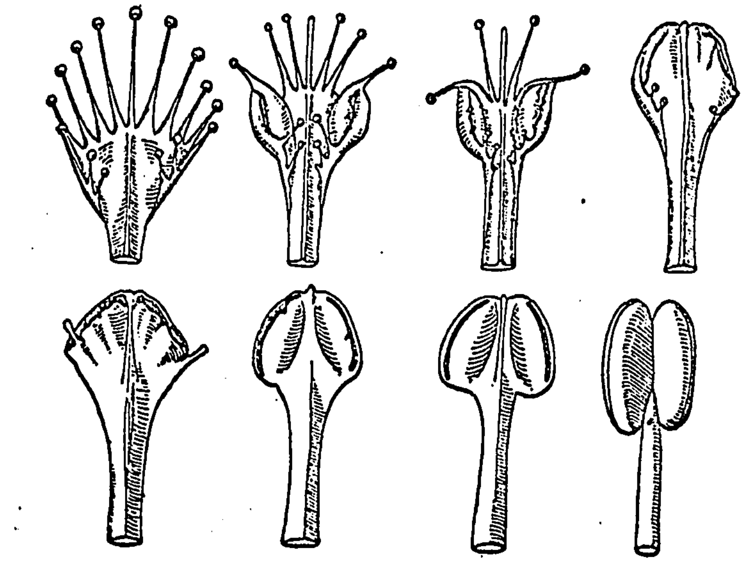
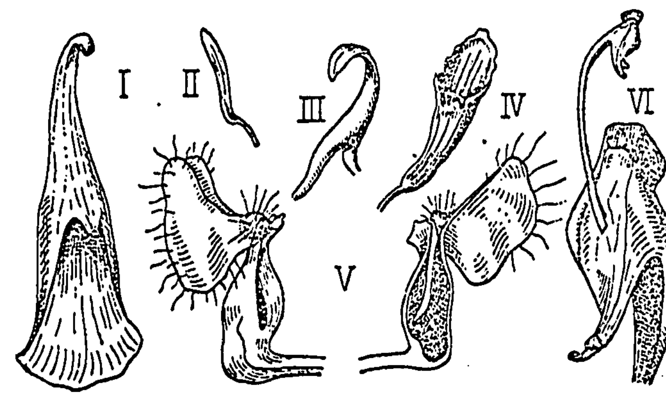
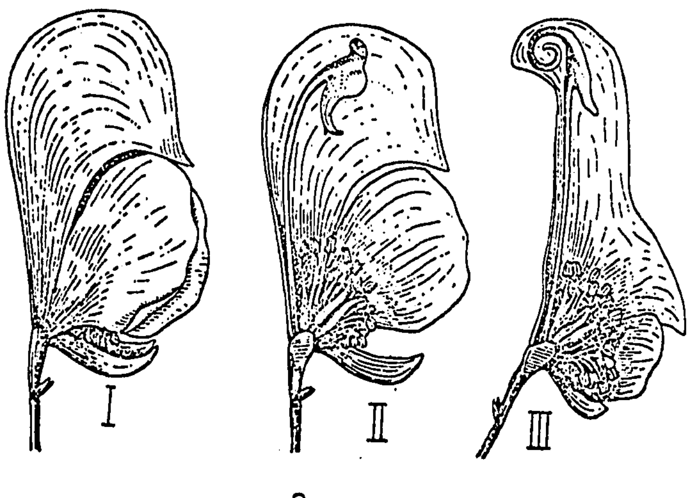


FIGURE 1

Intermediate forms of stamens and nectaries
in *Parnassia* (after Wettstein).

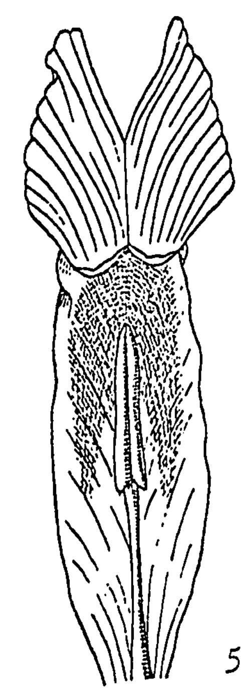


2

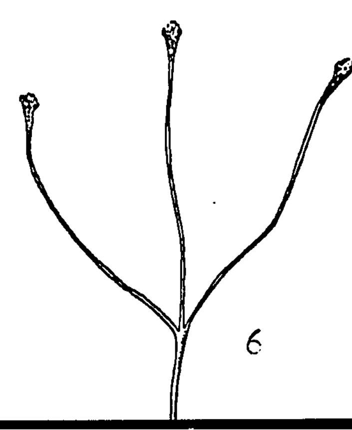


3

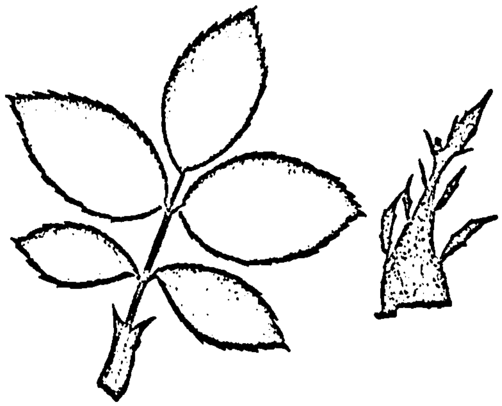
4



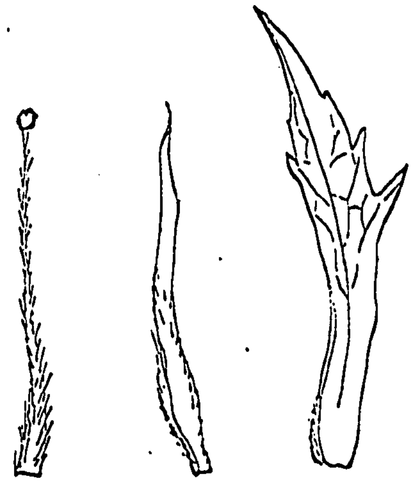
5



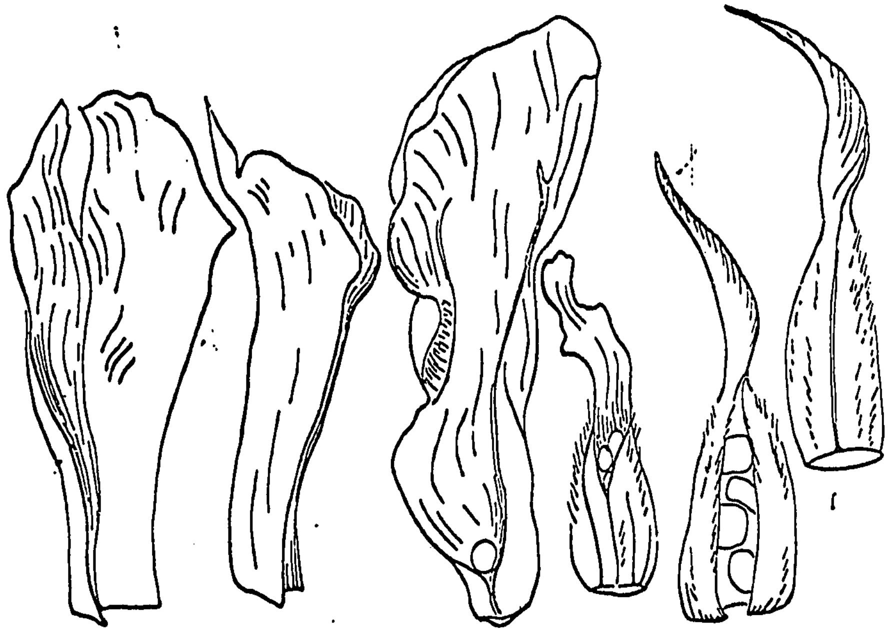
6



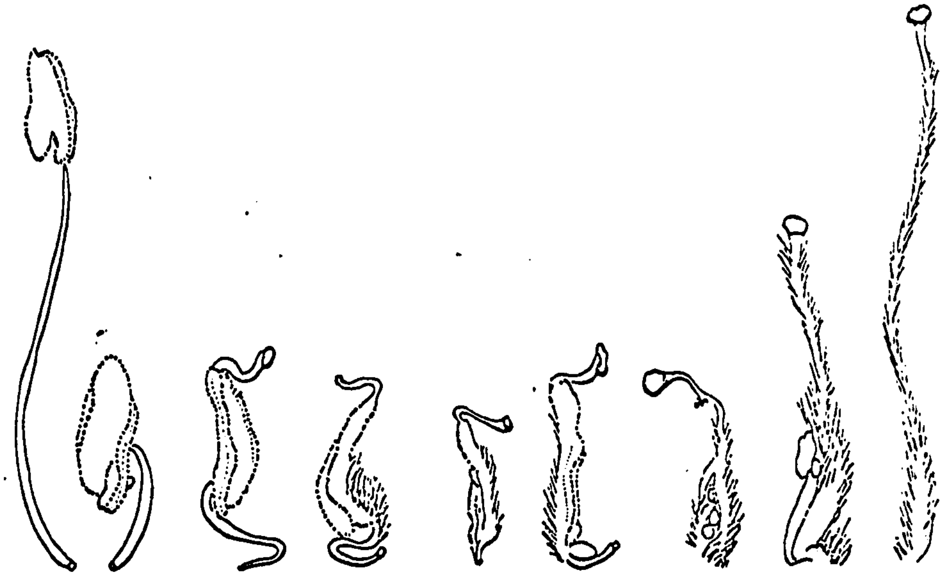
1



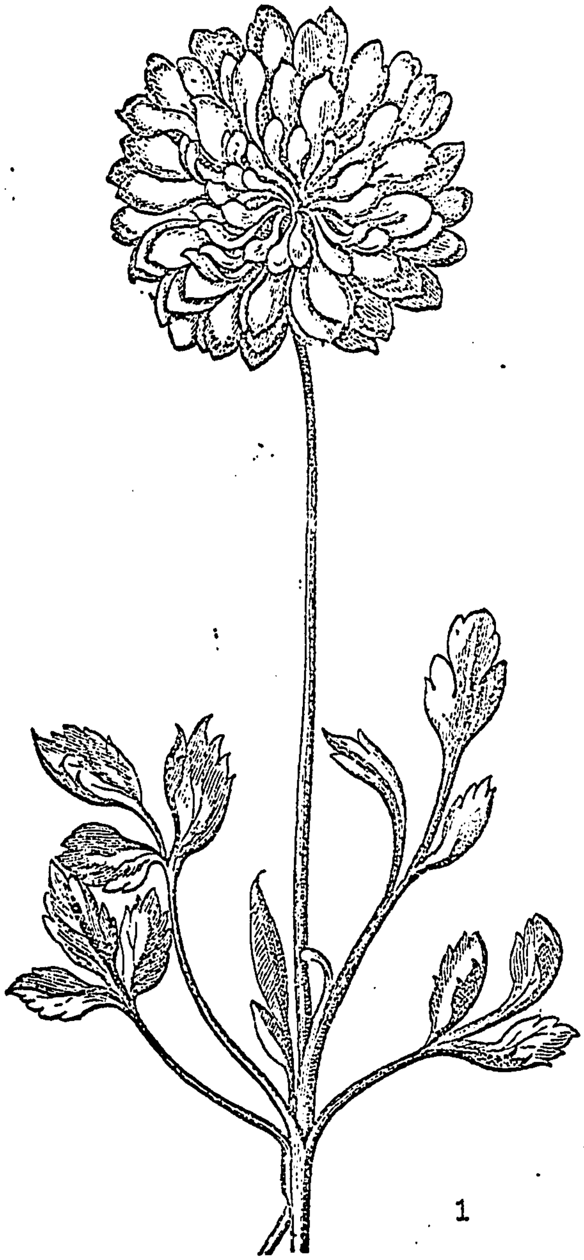
a b c 2



a b c d e 4

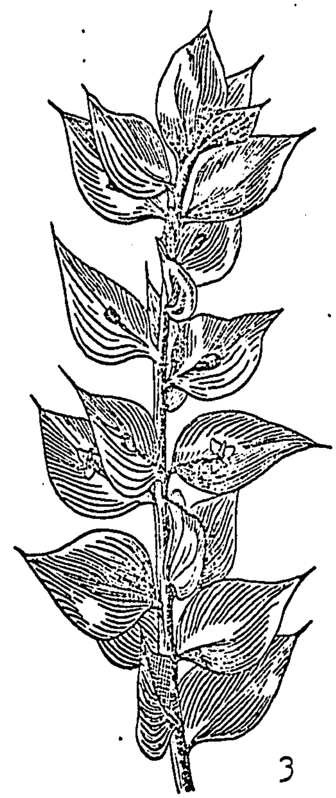


3



1

2



3

4

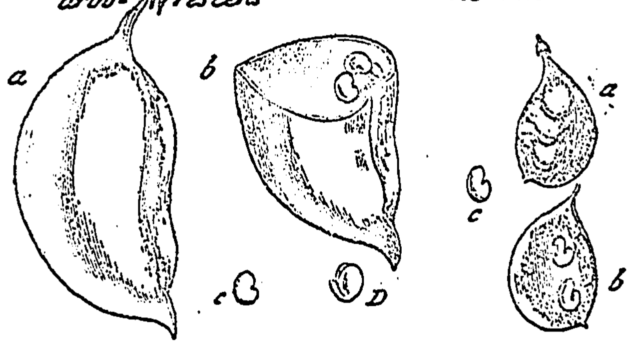


FIGURE 1

Hulls of *Colutea arborescens* and *Colutea herbacea*, showing their leaf character (after Gaertner).

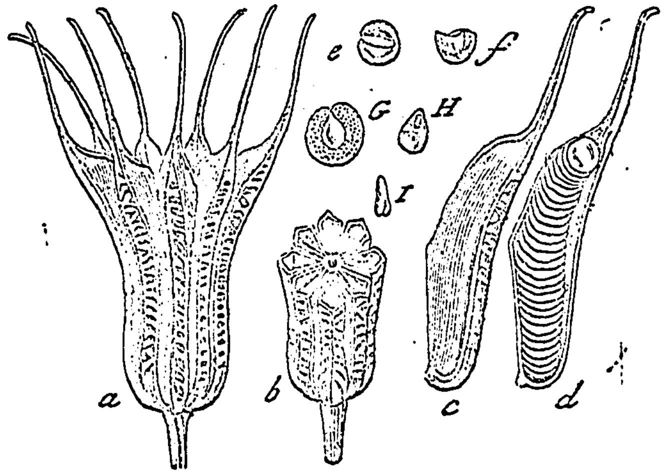


FIGURE 2

Nigella orientalis (after Gaertner).

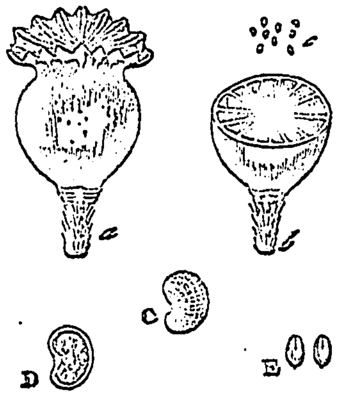


FIGURE 3

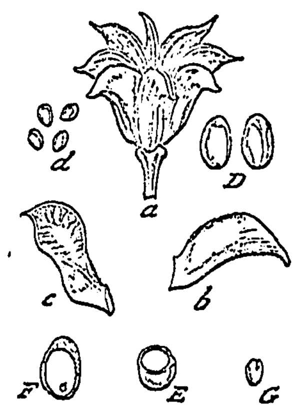


FIGURE 4

FIG. 3 –Fruit capsule of poppy, *Papaver orientale* (after Gaertner).
FIG. 4 –Fruit of marsh marigold, *Caltha palustris* (after Gaertner).

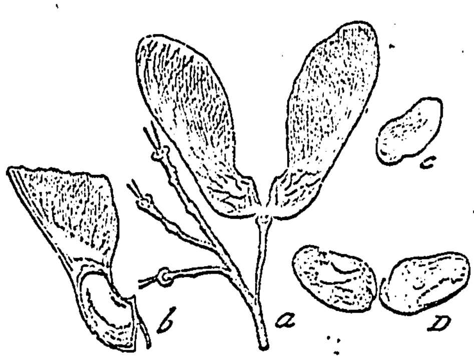


FIGURE 5

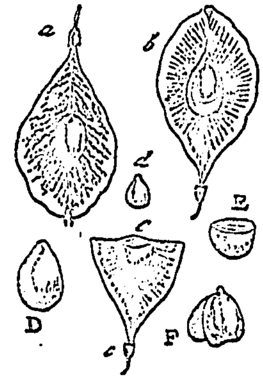
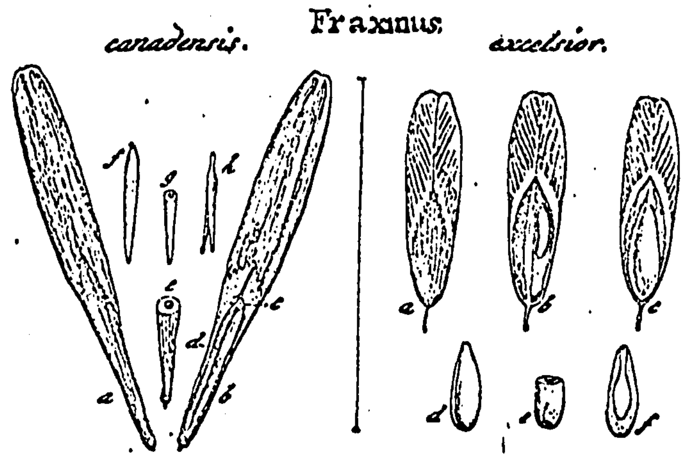
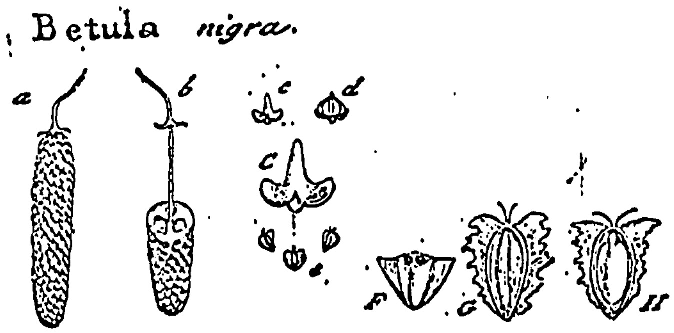


FIGURE 6

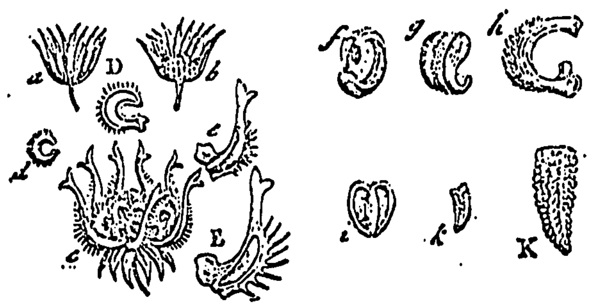
FIG. 5 –Fruit of maple, *Acer tataricum* (after Gaertner).
FIG. 6 –Fruit of elm, *Ulmus americana* (after Gaertner).



1



2



3

4

II Historical Interpretations

Schiller had termed the basic schema, if I may call it that, of the Metamorphosis of Plants a speculative Idea rather than an empiric experience. Any discussion of the text should begin with this criticism, since it is utterly basic to the whole enterprize, and so my own will proceed. But this creates certain problems which may not be immediately visible to the reader. The morphological method used in Goethe's text are quite similar to those used in biological morphology in general, and thus, since Goethe's age, biology has had a good deal to say about them, and even about Schiller's critique. The reader who is innocent of these interpretations (put forward within biological thought) could perhaps proceed directly to the discussion of the next chapter without difficulty. Those who know anything of biological theory in this area, however, may be confused to find that I do not rely upon the accepted interpretations, but proceed as if they were manifestly inadequate. In order to make this inadequacy manifest to the reader, I have therefore, inserted this parenthetical review of the history of biological theory during the development of the science from the time of Linnaeus to the advent of 'modern' biology. It is my intention, in this chapter, to raise, claify, and subsequently dismiss, the claims of 'explanation' of morphological relations put forward by biology since Darwin, in order that we may turn, in the succeeding discussion, to the heart of the problem.

When the scientist approaches a particular set of phenomena, in our case, those of organic life, and asks such questions as "What is this?" or "How does it come about,", he thinks to find some revelation on the subject in the information that he can gather from the 'facts' themselves, assuming that these 'facts' are in some way interconnected, and that study of them may eventually reveal such relations. This is a heuristic principle in the best sense, for we may easily see that (1) if the individual 'facts,' or empiric observations, are not connected or connectable, then investigation of them could never yield anything beyond mere perception of them, and the goal of science would remain unattainable, and (2) if connections are found, then they were, in a certain sense, indigenous to the phenomena, and could not be termed a 'result' of the heuristic assumption, or if they are hypothesized and the hypothesis is shown to have predictive power by experimental trial, this predictive aspect is factual rather than assumed. But once the scientist commits himself to this methodological assumption, as indeed he must in order to further any sort of investigation, alternative modes of 'observation' arise.

There are many observations to be made upon even the most trivial incident. Which are the crucial ones; which accidental? In the early 1850s biologists looked upon _form_, whether visible to the naked eye or only with the help of a microscope, as the most important aspect of biological phenomena. It does not seem overly speculative to suggest that the emphasis is today upon electro-chemical and genetic relations, visible form being one of the less important aspects studied (except in paleontology). But since form has not been discarded altogether, we may yet find ourselves asking what the import of this or that structure might be; what can it tell us about organic life? (This may also be asked about chemistry or what have you, but our problem here is that of form, and thus it is prudent to keep to that example.) The significance of form is an open problem, even today, for biology, but the modern outlook does offer partial answers. Given that we are interested in these—that we have made form the focal point of our present investigation of organic life—what further choices must be made?

We may answer this question most easily by looking at the double aspect of the term "significance." A 'significant form' may be (1) a form which signifies something, in the active sense of that word (as human words signify a meaning), or (2) an evidence which is passive to our interpretation. This is the distinction to be made between a symbol and a sign. The latter, like (x) in algebraic usage, is multivalent; it 'stands for' anything we intend it to. The form of the letter, its sound, the color of the ink used to form it, have not relation to its assigned 'significance.' How different are the sounds of a symphony! The choral movement of Beethoven's ninth symphony, for example, is sometimes said to express triumphant joy. The words of Schiller's poem speak of it, and the music 'signifies' or 'expresses' it as well. But notice that the music does not simply 'stand for' joy. If this were its relation to the audience, it could just as well be assigned a significance of defeat and mourning. This latter assignment however, is not possible, given that the audience are members of european culture. They simply hear joy, or at least elation, in the sound. The actual sound is, of course, not joy, but its symbol. When we listen, we participate in the 'joy' of the movement through the sound, in the symbolized through the symbol (for so I would use these terms). Thus we have two possible relations between observer and observed: that of a sign, passive to our assignment for it, and that of a symbol, which, at least within the culture, signifies or expresses something more than itself to immediate reflection (without further interpretation).

This distinction is crucial to the scientific observer. It is omnipresent whenever any thing or event is examined. The observer cannot help falling upon one side or the other of these two ways of seeing, and usually has a foot in both camps. When one billiard-ball strikes another, for example, do we 'feel' something dynamic, a type of 'energy' or 'force' (as is suggested by the sense of activity in the word "strikes"), or do we merely note that one ball moved, came to touch another, then slowed, while the other ball, which had been at rest, changed its state to that of movement? The first way of seeing, which finds some expression of 'force' in the event, is symbolic, while the second is not, or at least is less so. In the former we look through the produced phenomenon to the productive cause (that is, this is one's impression); in the latter we see only the phenomenon which has been produced, and must speculate about a cause for this effect.

Given, of course, that accusations of 'imagination' or 'animism' may be leveled against the observer who 'sees' a productive nature within or through natural events (through that which is produced), my point is only that such events <u>may</u> be so represented to the mind. We may 'look' at things in this manner, whether or not we are correct to do so. Thus we seem to have <u>two</u> ways of making observations (or at least, observing seems to have two poles), and this fact has led to no little confusion.

Throughout the history of biology, and probably that of every major science, we may discover figures whose opposition to each other is founded in a difference in mode of

<u>observation</u>, rather than upon the nature of the logical operations which follow this first moment of investigation. Some men look <u>through</u> events, others look <u>at</u> them. The results will of course, differ, but they are often quite unclear about the reasons why. Let us turn now to the manner in which this alternation arises in biological theory.

As the reader will probably remember, the metamorphic leaf-sequences of Plates VI - VIII are almost impossible to view <u>without</u> the imaginative addition of 'movement.' When such a group of leaves is presented to an investigator, no matter that they are in a random order and the investigator totally ignorant of botany, the sequence of the Plates is quickly discovered. Seeing both similarity and difference in the forms, the eye is quick to look for continuity in change, and thus for continuous transformation. To find this, of comrse, the forms must be put in the 'proper' sequence, but such an operation takes but a few seconds. Placing any two leaves next to each other, the investigator then brings a third into proximity and decides whether it 'fits' on the left, the right, or the middle. If any of these choices seem to result in a 'break' in the 'movement,' it is rejected. If continuity of 'movement' results, the suggestion is accepted. (This is a somewhat simplified description of the procedure followed by the students I gave such leaves to. Some were quicker than others, but all came to the same results by stumbling on to the same method in a remarkably short time.) So strong is this sense of continuous transformation of form, or 'movement,' that the observer is tempted to believe that it tells him something vital about the plant, and this can create problems.

The observer who looks through the sensible phenomena will, in this case, focus upon the 'movement' that is made visible through the sequence of individual leaves. If this 'movement' is taken to be an empiric fact, then it will obviously represent something dynamic, an expression of energy. The recognition of this manner of viewing metamorphic sequences led a German morphologist, G. F. von Jaeger, to complain in 1814 that the term 'metamorphosis' refers to a symbolic viewing of the phenomena, and is in reality no more than a figure of speech.[1] We do not, he noted, witness the transformation of one leaf into another. The actual transformation or metamorphosis is an imagined one which happens not at the level of the physical individuals but within the formative forces (Bildungskräfte), and we take the leaf-sequence to be the expression of this. At best, this criticism leaves us with an imaginary hypothesis which may be descriptively useful but must not be made into a causal theory (the figure of speech should not be taken literally). Of course, Jaeger himself did not favor the 'expressive' or symbolic treatment of phenomena, while Goethe did.

Jaeger's objection is closely related to that of Schiller; both depend upon a similar notion of what is, and what is not, a fact of observation. The actually sensible is acceptable to both men, but the symbolic or expressive 'content' of the sensible phenomena is not. When we examine the sort of perception utilized in the text of the <u>Metamorphosis of Plants</u>, it becomes obvious that the 'movement' or 'metamorphosis' of form is a crucial point. Indeed, it is well-nigh the <u>only</u> point, for, as we have seen, the departure from Linnaeus begins when the observer turns his attention from stasis to movement. Although the term <u>metamorphosis</u> is applied to vegetable transitions in his work, both Linnaeus and the systematic botany of his followers paid little attention to the 'movement' of forms, preferring to attend almost exclusively to the <u>Gestalt</u>, the static figure. This could be 'seen' and understood clearly; its status as evidence was unquestionable. But the moment the investigator shifts his attention from the <u>Gestalt</u> to the <u>Bildung</u>, von Jaeger's objection becomes a serious one. In what sense is the 'movement' real? The leaf forms are there—they may be traced on paper or photographed—but their 'movement' is not physically present. Can it be anything more, then, but a hypothesis?

This question becomes the responsibility of any theorist who takes such 'movement' of organic forms to be empiric evidence rather than mere hypothesis. One of these theorists, it would seem was Charles Darwin himself, and the notion is of some importance to most Darwinian or Neo-Darwinian positions on evolution. This being the case, one would expect that biology would have been forced to defend itself from Kantian criticisms, and that such a defense might be found in its nineteenth century history. And this is indeed the case, although such things are not easily researched.

The historian of a period often attempts to make the positions of its major figures a good deal more defined and clear-cut than they actually were. It is his job, he seems to believe, to 'make sense' of this history. Much of his difficulty comes from the fact that he is looking backwards, and has the interests of a modern outlook in mind. Such attempts at definition are therefore aimed at 'fitting' the contributions of the figures examined into a theoretical picture which did not come into existence until quite recently, and which could not, for that reason, have been the context of those contributions. Yet without such treatment, the events of a history will not be immediately intelligible to the modern reader. (See, regarding this problem, Thomas Kuhn's discussion in the eleventh chapter of The Structure of Scientific Revolutions.)

In my own examination of biological history I found that questions of the sort advanced by Schiller and von Jaeger were never actually answered, but were mistakenly thought to be answered several times over: that the 'movement' of organic forms was never actually explained, but was thought to have been accounted for: and that this 'movement' was often defended as hypothetical by the very man who was, in his actual practice, accepting it as empiric fact. Unfortunately, the approach to morphology that seems to have codified these confusions is that which is still current, and the viewpoint it provides is still the context in which most readers attempt to see the events of biological history. In order to discover, then, what actually happened to our 'question,' as posed by von Jaeger, it will be necessary to look upon the period under review with a cultivated innocence; to look not merely backwards from our present sophistication, but also forwards, at least as well as we may imagine the picture, in order that we may clear away the answers that we might otherwise be tempted to offer.

In the hundred years that follow the death of Linnaeus, biology made two major advances in taxonomy (and the morphological theory behind classification): the first was the departure from 'artificial' systems of taxonomy to those based upon common structural plan; the second was the reinterpretation of the latter approach along phylogenetic lines after the publication of Darwin's Origin of Species. During the first period the 'question' above was an open one, if unanswered. During the second it disappeared from view behind answers which are not actually addressed to the right question. I shall attempt to portray this general movement of thought through selected figures, but these are by no means the only possible selection and may not be the best one. They do, however, suit my purpose of clarifying certain schools of thought.

I shall divide the discussion into three sections: (a) the development of a taxonomy of structural plan; (b) pre-Darwinian attempts to find a material explanation for common or archetypal plan; (c) the Darwinian thesis and its victory. For the duration of this discussion I must ask the reader to remember that we are forcing the men examined to answer a question that they have never clarified for themselves and thus never intentionally answered. We cannot ask these men about our problem directly, but must, rather, ask related questions and make inferences from the answers given to these.

(a) <u>From the death of Linnaeus to Sir Richard Owen's discussion of the Archetype of the vertebrate skeleton in 1847</u>

The <u>Systema naturae</u> of Linnaeus ordered the "kingdoms" of nature into classes, orders, genera, and species, on the basis of what has come to be termed an 'artificial' distinction. In the realm of plants for example, Linnaeus distinguished classes according to the number of stamens and orders by the number of pistils. Further classification was done upon like grounds. This allowed him to develop a very clear system of taxonomy which was of great service for purposes of identification. The author of the <u>Systema</u> however, was its first critic, and he sometimes departed from the characterization by number alone in order to recognize obvious similarities in certain groups. By this action he proposed a taxonomic goal far beyond that which his work had reached: the classification of nature according to actual affinities rather than distinctions which, while they are easily made, may not reflect such affinities. His 'artificial' system was already evolving toward a 'natural' one, or a toxonomy based upon 'common agreement' of <u>all</u> parts of the organism.[2]

After his death in 1778, Linnaeus' work was carried on by his many pupils, but although these men contributed much to the known catalogue of organic life they did not manage to advance the cause of a natural classification. This task fell into the hands of others. Georges Buffon and his colleague Daubenton pioneered a comparative study of anatomy, insisting that animals be investigated with respect to major organs such as bones, heart, brain, respiratory system, etc. Petrus Camper, at The Hague, made a number of comparative studies, including one between the bone and muscle structure of the orangutan and man, demonstrating that the former was unable to walk upright. John Hunter began a private collection in London, in which each item was arranged according to its anatomical relations, which was to become the basis of the British Museum of Natural History. Vicq d'Azyr, Buffon's successor at the French Academy, emphasized the unity of each organism, pointing out that a certain type of tooth implies a certain type of digestive system and a matching mode of life. Yet if such figures created the possibility of a taxonomy of 'common agreement' of all parts of the organism, they were not able to bring this to actuality. The shift to classification by common plan required more than new techniques.

The comparative method was not seen, by most eighteenth century biologists, to have the potentials we can see in it today. A change in thinking had to come first. As long as the anatomist thought of the organism as a mere collection of parts, the totality of which could be reached by summation, the later notion of a common plan could not arise. When the organic came to be thought of as a realm in which a more intensive unity than mechanical was manifest however, the results of comparative anatomy could be seen in a new light. Goethe's own departure in this direction was abrupt and total, and because of this his contrast with the more conservative figures of his day is marked. He may be used, therefore, as a weather-vane of sorts, the reactions of his first scientific papers revealing very clearly the quarter of the prevailing wind.

In 1784 Goethe circulated privately a treatise on morphological osteology, the subject of which was, specifically, the presence of the intermaxillary bone in vertebrate skeletons, but by implication, the principle at stake was clearly the common plan of vertebrate skeletons. (The intermaxillary is the bone in which the teeth of the upper jaw before the canines are imbedded.) His thesis was generally rejected, and the paper had to wait twenty years to find a friendly audience.

The most notable name on Goethe's mailing list was Petrus Camper, and since his comments summarize the prevailing attitude, we may limit our examination of the response to his. Camper had already done work which was to become instrumental in founding the taxonomy of common plan. He had demonstrated, through drawings, that many of the bone structures found in vertebrate animals are in a certain sense identical. For example, given a drawing of the bones of the human hand, a good artist may, without changing the basic plan of the structure, but merely altering the proportions of its elements, transform the picture into one of a bird's wing, or the pectoral fin of a porpoise. In this way he demonstrated that these organs were built upon a common pattern. One might expect, therefore, that Camper would be very friendly to any suggestion of a common plan for vertebrate skeletons, yet this was by no means the case.

Even as he would argue, in the 1790 text of The Metamorphosis of Plants, that all parts of a plant 'moved' into one another, so Goethe, in the osteological treatise, saw all vertebrate skeletons as transforms of one another. He argued that they must all have the same basic structure, and attempted to prove that the intermaxillary bone, which did not seem to be present in man and some of the larger mammals was indeed present in all. Camper received the paper in 1785 (private circulation was rather slow it would seem) and let Goethe know that although he was to be congratulated upon the discovery of the bone in the walrus, Camper could not allow that the bone was present in the human skull. He wrote Goethe again in 1786, saying that despite numerous observations, he still could not agree that the bone was present in man, and the obvious inference to be drawn was, of course, that the human skeleton was not based upon the same plan as the rest of the vertebrates.

A close look at the arguments involved reveals differences in point of view that are too often overlooked. Camper noted that the upper jaw of the human skull showed no evidence of sutures, while such sutures (distinguishing the intermaxillary from the maxillaries) were present throughout the rest of the vertebrate kingdom. Goethe agreed that this was the case, but argued that the sutures were invisible since the intermaxillary in man has fused with the maxillaries. Although Goethe had no knowledge of the fact at the time, the intermaxillary is clearly separated in the human embryo, and thus his theory that its edges grow together in a complete fusion rather than a visible suture was quite correct. At the time, he had already noted that when the human jawbone is split, differences in bone texture allow the eye to distinguish the intermaxillary region from that of the maxillaries (the textural difference evidently makes a rough demarcation just before the canines). In the succeeding years the embryonic evidence and an example of a man whose intermaxillary was yet quite distinct from his maxillaries were brought forward, and the theory began finding friends. But when the paper first appeared it had none, and Camper, although he may well have known the embryonic evidence, was intransigent in his resistance.

Why was this the case? Why should something which seemed so obvious to later morphologists seem so obscure to those of Camper's mind? The answer seems to be that by 'intermaxillary bones' he and Goethe meant quite different things. To Camper, the bone was there if it were divided from the rest of the jaw by sutures and not otherwise; that is, only if it could be seen to be a separate object. For Goethe, the bone was but the imprint of the formative processes of the human organism, and the fact that the sutures had undergone total fusion did not mean that the bone could no longer be distinguished from the rest of the jaw. One may distinguish conceptually where he cannot physically divide. The human upper jaw was one piece of bone, but revealed a number of formative processes. That of the intermaxillary was quite different from that of the surrounding bone. But Camper did not budge from the static evidence; there were no sutures in the upper jaw.

Goethe's first congratulations on his theory were received from Herder, which is in itself a rather telling fact. Herder had begun work on his Ideas on a Philosophy of the History of Man in 1783, and Goethe was familiar with the thesis. In the first part of this work, Herder postulated that one may think of all of nature in terms of a single primary form and multiple manifestations. Goethe's notion of the vertebrate skeleton certainly reflected this, and he undoubtedly received a spur from Herder's ideas. When he sent the work on the intermaxillary to Herder, agreement was quick to follow. But most men were not thinking along such lines.

Goethe's 1790 publication of The Metamorphosis of Plants also lacked an audience during that century, coming into conflict, as it did, with the same outlook that had met his 1784 paper. So Hegel wrote:

> Goethe with his great insight into Nature had defined the growth of plants as a metamorphosis of one and the same formation. His work, The Metamorphosis of Plants, which appeared in 1790, has been treated with indifference by botanists who did not know what to make of it just because it contained the exposition of a whole.[3]

The same fate awaited his 1795 paper on an archetypal form for the animal world, in which he argued, somewhat like Aristotle, that natural science is based upon comparison, and concluded that the standard of comparison in the organic realm must be an ideal type, the mean of all forms. If comparative anatomy had moved away from Linnaean analysis, it was still entrenched within a rather Linnaean vision of evidence. Facts were static details which would be physically divided from each other, and all theory was to be based upon such 'facts.'

Historians differ in their estimation of the importance of Goethe's work as an influence for later thought and I think that we may profitably bypass any consideration of this problem since we need only know, for this discussion, the manner in which opinion changed, not the reason why. With this in mind, we may pass directly to the most commanding figure of pre-Darwinian biology, Georges Cuvier.

Cuvier was born in 1769 and educated in Stuttgart. He was appointed an assistant at the Musee d'Histoire Naturelle in Paris in 1795, the date of his first publication. As his fame grew, he attracted attention within the government and Napolean selected him to direct the reform of education throughout France, a position he managed to keep even on the return of the Bourbons. He became a figure of great authority and power, a giant in the eyes of his contemporaries.

Cuvier is considered the father of modern taxonomy. His contributions modernized comparative anatomy and practically originated the science of paleontology. His reading included Herder and Goethe, but he knew Kant as well and was very concerned with the third Critique. He was a careful investigator, not given to saying more than he could demonstrate, and occasionally acknowledged Kant's guidance in his restraint and refusal to speculate. He was also commited to the Kantian notion of the organic, and therefore to a notion of unity which was more than the sum of its parts. It was Cuvier's application of this guide to the results of comparative anatomy that initiated the new taxonomy, and by so doing, prepared the ground for Darwin.

In his first year at the Musee d'Histoire Naturelle Cuvier produced a paper which argued that Nature structured her animals upon a limited number of basic plans. In his later publications he worked this notion into a definite comparative approach, finally reaching, in his Le Regne Animal of 1817, his famous system of embranchements. These were four general groups into which he divided the entire animal kingdom: I. Vertebrata; II. Mollusca; III. Articulata; IV. Radiata. They were internally subdivided into classes, and these into smaller divisions. In positing such a division of Nature Cuvier announced that he judged it totally wrong to arrange organisms in a 'ladder,' as had previously been the case, beginning with the simplest and rising gradually up to man. There was no basis for this comparison, he argued, for a crab may represent just as perfect a realization of his basic plan (articulata) as a man did of his (vertebrata). Thus modern taxonomy was launched, and so well did Cuvier do his job that the first three of his groups may be said to be still preserved, if modified, in modern classification (the fourth has been thoroughly broken up).

As we look closer at these distinctions, we can perceive a minor triumph for the point of view advanced by Herder and Goethe. This was, the reader will recall, that variation within the organic realm was actually but modification of a single primary form. Cuvier did not posit a single plan for all organic nature (nor had Goethe—he suggested one for plants and another for animals), but he did conclude that all zoological variation was but modification of four base-plans, or primary forms. This resemblance may be traced for some distance.

Goethe had separated form and function in his treatment of plants, making all forms essentially variations of one form, but positing no such unity in the realm of function. The function of a stem leaf is obviously not that of a stamen, but the same form may be a basis for both. Even so, Cuvier structured his common plans, or types, upon such a separation. Previous anatomical studies tended to make function the crucial aspect, coming, as they were, from medical concerns. Cuvier noted that there was good evidence that form,independently of function, should be a basic concern of the anatomist. Respiration, for example, was a function that was easily recognizable throughout the animal kingdom, but within different groups it could be performed in such a different manner that no real comparison between the organs of respiration was possible (insects do not breath with lungs, nor do fish). One could, in addition, move in the opposite direction and trace similar forms which exhibit different functions (the lungs in man and the air-bladder in fish— the latter functioning to adjust bouyancy but being unrelated to respiration). It seemed as if Nature had a number of functions to be fitted within a number of forms, and went about this 'fitting' in various ways, not always matching the same function to the same form.

On the other hand, if form was somewhat independent of function, and, vice-versa, the two aspects were also inter-related. The particular combination of form and function found in a particular animal determined the nature of that animal. Within the basic plan of vertebrata, the forward limbs may be varied to be suitable for flight, or for catching and tearing prey, or for grasping (as Camper had shown with his drawings). But the functions mentioned designate three different life-styles, and these in turn assign other functions. The claws which are adopted for running (retractable) as well as for attack (extendible) are obviously those of a carnivore. Since a carnivore must digest meat, he has to have the proper stomach for the task. If the limbs are hooved rather than clawed, however, the animal must be a grazer rather than a carnivore, and needs the stomach of a ruminant. Thus there is a particular correlation of parts which is demanded by particular life-styles, and the possible combinations of form and function are governed by such demands. The study of form reveals the basic structures upon which living organisms may be built; the study of function shows those processes which must be maintained by the structure in order to support life; and finally our knowledge of actual environmental conditions shows us just what sort of combinations of structure and function can be successfully joined.

In these considerations we may detect a sense of unity which cannot be thought to be merely mechanical. Indeed, such is Cuvier's intention:

> Every organism forms a whole, a unique and perfect system, whose parts are mutually correspondent and concur in the same definite action by reciprocal reaction. None of these parts can change without the whole changing; and consequently each of them, separately considered, points out and marks all the others.
>
> If, for instance, the intestines of an animal are so organized as only to digest fresh meat, it follows that its jaws must be constructed to devour a prey, its claws to seize and tear it; its teeth to cut and divide it; the whole structure of the locomotory organs such as to pursue and to catch it; its sensory organs to perceive it at a distance; and nature must have put into its brain the necessary instinct to know how to conceal itself and to ambush its victims. Such will be the general requirements from a carnivore; every animal of this diet will invariably unite these qualifications, for its species could not survive without them all. But apart from these general requirements there are particular ones, relating to the size, species, and haunts of their prey. And each of these peculiar conditions results from modifications of the morphological details, which they derive from the general conditions. Thus, not only the class, but also the order, the genus, and even the species are detected in the formation of every part of the body.[4]

Cuvier boasted that from like considerations the researcher would eventually be able to reconstruct the whole animal from a single bone. This is, of course, still not possible, but

Cuvier and his successors in paleontology often came so close to the feat when reconstructing fossil organisms (from one or two fragments before a complete skeleton had been collected) that the boast was obviously not an empty one. The unity of the animal, and the resultant correlation of parts, had been thrust into the foreground, and a prerequisite for this correlation was the recognition of common structural plan.

Returning now to this latter consideration, we may see that within any group, such as vertebrata, a difference in life-style means a shift in the manner the basic structure is adapted to the functions. But in order to think in this way one must have some notion of what a basic structure, or common plan, is. For Cuvier's vertebrata we may indicate this roughly by listing an internal skeleton, a spine, a continuous spinal cord and brain, a heart and blood vessels, and a basic plan for the skeleton which consists of an axis of skull and vertebral column. This is of course an extremely bare description, but let us turn to the common skeleton and look closer.

Besides the basic plan of the bones described above, we must also mark the manner in which that plan may be varied. As Camper had illustrated, the skeletal structure modifies by changing proportions and maintaining pattern, or relatively similar to the manner in which the appendages of a plant may be said to modify (all leaf structures are built upon veins which either fill up the space between branches with tissue or fall short of filling in various ways, and vary between many branches or few, pinnately or palmately branched). When the 'same' structures (the bones of the human hand, the fin of a porpoise, or the wing of a bird) are placed in juxtaposition to each other, a 'movement' between them is easily imagined, and was drawn by Camper, who made his changes in small increments. At times we even find such a series of pictures as Camper drew in nature, and have only to arrange it in the proper sequence to have our notion of 'movement' reinforced (see Fig. 1, Plate XV). We can 'see' quite clearly then, that such forms may 'move' into one another, and we therefore postulate a continuity, something in common for all, but can the common element be identified?

Cuvier did not speculate upon the nature of the common form. It was enough, for him, to note the obvious geometric similarities of the skeletal parts and to understand, thereby, the vertebrate skeleton as a single plan. The scheme worked, and few worried about why. In a sense, this attitude was built into Cuvier's metaphysics, for he was a professed Kantian, and was convinced that we could never understand <u>why</u> organic nature could be treated in this manner. He wrote:

> We cannot explain these relationships, of course, but we may and must assume that they are no mere play of chance. As the equation of a curve contains all its characteristics, and as each of these can be used to derive the equation and with it all other properties, so a nail, a scapula, a femur, or any other bone by itself will give information regarding the teeth and conversely. One who knew the laws of nature's organic economy and applied them with understanding could start with such a fragment and from it reconstruct the whole animal.[5]

The _type_ was then a descriptive classification, and in this sense empirically derived and therefore not 'artificial.' But the type concept revealed simply _how_ things were, not _why_ they were, and this latter question was considered to be a different subject and beyond our purview.

Of course, if anyone took the 'metaphoric' language of the morphologist too literally, and decided that there really were such growth forces or processes as were implied by this language (von Jaeger's interpretation), then he would also come to believe that the _why_ of organic forms was being partially revealed with the _how_, since the creative processes or forces could be seen through these forms. Cuvier made no such assumption, at least consciously, but his friend Geoffroy St. Hilaire did. The famous debate between them in the French Academy is too long to go into here, but the resultant positions are of interest.

For all practical purposes Geoffroy seems to have cut a less convincing figure than Cuvier. He attempted to postulate a "rational unity" behind all zoological forms, thus cutting across Cuvier's types. For this purpose, he made ample use of embryological evidence, noting similarities in early development. Cuvier, while recognizing the value of such embryological work as Geoffroy had contributed, argued that the attempt to cut across types was based upon mere analogies which were bound to arise due to the fact that the laws of function, which were given to all life in general by the physical realities of the environment, did indeed cut across types (all animals needed digestive, respiratory, and nervous organs, for example). Since analogies would always be possible upon this basis, it should not surprise us to find them. But neither should we confuse such analogies with a similarity of basic plan (that of vertebrata with mollusca, for example), since plan varies independently of function. Geoffroy's statement that, from his standpoint

> there are no different animals. One fact alone dominates: it is as if a single being were appearing.[6]

seemed to Cuvier simply incorrect (an error based upon improper separation of function from plan), and his belief that this single being

> resides in animality; an abstract being, which is tangible to us through our senses in diverse figures.[7]

was for Cuvier pure fantasy.

For Geoffroy, we may say that he seemed to understand Cuvier's criticisms, but to argue that these did not apply to his own work. His major criticism of Cuvier was that the latter considered only facts that could be sensibly perceived, and would not admit that any rational principles could be expressed by these facts. We are already in a position to know why Cuvier, a Kantian, would be reluctant to do this. And there the matter ends, at least for several years.

What had happened since Linnaeus' death? Biology had become more firmly rooted in empiric studies, its taxonomy descriptive, its methodology comparative. Cuvier had shown how the human intellect could penetrate into the actual structure of organic life; he had distinguished form and function, noted the laws of their interrelation, and identified four base-plans for the structural half of that dichotomy (one of which did not survive his death). Geoffroy could show no comparable accomplishments, but his work, centered upon form, was to bear fruit through the efforts of later figures.

On the theoretical side, the notions of organic unity coming from Kant, Herder, and later Schelling and the German Naturphilosophie made it impossible to return to a Linnaean taxonomy. Yet no victory could be said to have been won for Goethe's view. His argument with Camper had been won, but the theoretical background was still not granted. Goethe was not looking for a Cuvierian morphology, but rather for an approach like Geoffroy's. He was very excited about the debate in the French Academy, and wrote an article in support of the views proposed by Geoffroy. This was because he took his language 'literally' as it were, and assumed that he was 'seeing' transformation, and therefore the transforming process as well, through the observed forms.

Cuvier's notion of 'law' in the organic realm was, of course, roughly that expressed by Schiller: a postulation of reason which fits all the observed circumstances (we might call it a 'model' today). The only certainty obtained was that of coincidence with historical experience—'so it happened last time also.' Geoffroy thought to find, however, a governing principle, something fulfilling the place of a type of causal control, in his 'laws.' This principle was the 'single being' which appeared to the senses in diverse forms. The formative processes and forces which an observer like Goethe might think he 'saw' in the forms were the actual gestures of this being. The formed organism (the only subject of Cuvierian morphology) was its deed. As Kant himself had foreseen, such a discovery would produce a rational organics, a law based upon rational necessity. But Kant had also denied that the human mind could think such a principle. Cuvier evidently agreed, and there the matter rested.

Neither Cuvier nor Geoffroy ever changed their positions, but others attempted to adopt and mediate them. Because it contributed so much to the Darwinian resolution, I have chosen to examine the mediation attempted in England.

(b) From the publication of Sir Richard Owen's views on the Archetype of the vertebrate skeleton in 1847 to the publication of the *Origin of Species* in 1859

In 1847 Sir Richard Owen put forward a thesis on the common plan of vertebrates which was to prove extremely influential for the next ten years. Owen was thought of as the successor to John Hunter in England and sometimes termed "the British Cuvier." He had become the head of the British Museum of Natural History, a very influential post, and for a time his situation did resemble that of Cuvier. He was not above using his position to force his views upon his contemporaries, however, and this enthusiastic habit may have made some antagonistic to his views who would otherwise have been more friendly. He made important contributions to paleontology, and his distinction between analogy and homology was crucial to subsequent morphology. The nature of this contribution must be understood before proceeding to his thesis on the archetype.

Following distinctions laid down by Cuvier, Owen attempted to draw a clear line between two types of relations, which he termed analogy and homology. An 'anologue' denotes

> a part or organ in one animal which has the same function as another part or organ in a different animal[8]

but a 'homologue' is

> the same organ in different animals under every variety of form and function[9]

The common-plan of a Cuvierian type is a unity based upon homology, of course, and therefore homology becomes a very important concept for comparative osteology. Owen himself was working towards the demonstration of the total homology of the vertebrate skeleton, which would have to include proof that every bone in the skeleton had homologues in every skeleton of the vertebrate group.

Owen noted that there were more than one type of homologous relation. There were three which should be particularly noted, in fact, and these were: special homology, an agreement between an organ of one animal and one of a different animal; general homology, a conformity of an organ or group of organs to the general type (common plan); and metameric homology, the repetition of organs within a single individual, such as the repetition of the vertebrae.

What Owen meant by calling two homologous organs 'the same' is somewhat difficult to determine. But obviously the vertebrae are in some sense all 'the same,' and in a similar sense so are the hand of a man and the 'hand' of a monkey. In general we can return to Camper's drawings here, and suggest that organs whose forms may be shown to grade into each other by successive changes in proportion of the parts may be called homologous. There is some sort of basic pattern kept throughout, and as long as this is so, changes in proportions may produce any number of variations on the same theme.

Following Lorenz Oken, a Naturphilosoph, Owen found that the common plan of vertebrates could be worked out as a repetition of generalized vertebrae. Each vertebra had to be thought of as potential to transformation. Some would show only small extensions of bone on either side, on others these same extensions would be magnified into ribs, or even limbs. At the end of the neck, the vertebrae would balloon outward into the brain pan, filled with the brain, a transformation of the spinal cord. The upper and lower jawbones were not vertebrae themselves, but homologuous of those bony extensions that could form ribs and limbs under conditions. Owen produced a sketch of a fish, suggesting that it came the closest to revealing his principle, and thus presenting the archetype (in the fish the bony extensions on either side of the vertebrae could be seen to grade slowly into ribs and limbs as one moved from the tail area forward. In this plan, all three types of homology become one, since the basic unity to be transformed is the vertebra, and thus all bones are either vertebra or their extensions.

Owen's thought made a definite impression upon British morphology, but it was not to be as lasting as the situation in the 1850s, when the common plan of vertebrates was generally termed the 'archetype,' might lead one to believe. By 1858 Owen's fame and authority were at their zenith. Yet he had spoken not only of archetypes, but also of Platonic _Ideas_ in connection with them, and had imported a good deal of German thought into England. Such a way of looking at things seems to be inherently alien to the English mind, and resistance was bound to mobilize sooner or later. As it turned out, it came sooner, in the person of Thomas Henry Huxley.

In the same year, Huxley, who a few years earlier was speaking, without a flinch, of archetypes, decided to launch an all out attack on _Naturphilosophie_ in biology, and in June of 1858 he delivered this in the form of a lecture before the Royal Society entitled "On the theory of the vertebrate skull." The occasion was the annual Croonian Lecture; Owen himself presided. Few could fail to recognize the attack on the chair.

The lecture is of special interest to this discussion since it correctly identifies a leaning towards the position of Geoffroy and _Naturphilosophie_ and attempts (1) to clean out all those objectionable speculations which have entered by this route, and (2) to mediate between what is correct in Geoffroy's position and what is correct in Cuvier's. (We shall not need any further examination of Owen's principles other than that given in the lecture, for Huxley's complaint demonstrates well enough the issue at stake.)

Huxley begins by proposing that the basic problem is the actual meaning of homology. He does this by showing how the question arises in the mind of the investigator:

> how can the intelligent student of the human frame consider the backbone, with its numerous joints or vertebrae, and consider the gradual modification which these undergo...without the notion of a vertebra in the abstract, as it were, gradually dawning on his mind; the conception of an ideal something which shall be sort of a mean between these actual forms, each of which may then be conceived as a modification of the abstract or typical vertebra?[18]

One may recognize, in the "vertebra in the abstract," Geoffroy's animal in the abstract, of which every sensible animal may be considered a modification. But if Huxley is fair enough to admit that the notion may arise quite naturally, he is also adamant upon his stand that the notion must be rejected. He must proceed, however, to develop an alternative view.

With the larger and contextual problem defined, Huxley moves to the immediate one, the theory of the vertebrate skull. This, he notes, must be differentiated from the theory that vertebrate skulls are all homologous, which it includes. The latter theory means only that every bone in a particular skull may find its homologue in any other skull. The former theory, however, proposed by Dr. Owen, would add to the notion of homology between skulls the notion of homology between the skull bones and the vertebrae. To test the theory of the vertebrate skull therefore, one must test first the theory of the homology of the skull, and then see if in the case of any particular skull its component parts may be found to be homologues of vertebrae.

Huxley now undertakes a long discussion of different vertebrate skulls (sheep, bird, turtle, etc.) and, having found many similarities, concludes

> But if propositions of this generality can be enunciated with regard to all bony vertebrate skulls, it is needless to seek for further evidence of their unity of plan. These propositions are the expression of that plan, and might, if one so pleased, be thrown into a diagrammatic form.[11]

The first test having come to a positive result, Huxley must turn his attention to the second problem. In the very next sentence he changes his tone, which, until now, has not hinted at any specific variance with Owen:

> There is no harm in calling such a convenient diagram the 'Archetype' of the skull, but I prefer to avoid a word whose connotation is so fundamentally opposed to the spirit of modern science.[12]

One can imagine the audience stiffening in their seats.

Now that the gage has been flung, Huxley is obligated to introduce an alternate method of dealing with the 'sameness' of homologous organs. He has already, however, fallen back upon

Cuvier, for the phrase "if propositions of this generality" in the quote above is but another way of saying that the 'laws' of homology are but generalizations of reason upon past experience. No archetype, or single being, appears here, but simply an oft-repeated and never yet contradicted set of relations which, when generalized (by diagram if preferred), act as descriptive laws. After his comparison of vertebrae to skull bones, Huxley finds that it is impossible to generalize about both in the way that one could generalize about the skulls, and concludes:

> Those who, like myself, are unable to see the propriety and advantage of introducing into science an ideal conception, which is other than the simplest possible generalized expression of the observed facts, and who view with extreme aversion, any attempt to introduce a phraseology and a mode of thought of an obsolete and scholastic realism into biology, will, I think, agree with me... that the doctrine of the vertebral composition of the Skull is not proven.[13]

Well, but what if we do not so agree? Has the lecturer produced any <u>argument</u> to the effect that the attempt to find a rational principle behind homology is actually a reoccurrence of "an obsolete and scholastic realism," or is this just guilt by distant resemblance? To his own mind, Huxley had, I think, offered the necessary argument.

Cuvier had condemned Geoffroy's comparisons of very unlike forms as a confusion of structure with function. Owen and others, however, had gone right on in Geoffroy's vein, using Cuvier's method as well as that of his friend. Thus it would seem that the morphological evidence may in some way have supported such comparisons of distant forms. (Huxley may accuse Owen of bad theory, but never of unfamiliarity with the evidence.) There may be, then, something worth saving in Geoffroy's position, but this is not his "ideal" mode of conception. It would seem, from the argument made in the lecture, that Huxley considers such a mode of conception to be self-evidently unsuitable for science once it is presented in its true light, that is, as pure speculation. To show these concepts (abstract being, animality per se, formative forces, etc.) for what they are, all empircal support must be removed, and Huxley believes that he can do just this.

In a sense, it was Geoffroy himself who suggested the manner in which the problem might be solved. He had made quite interesting use of embryological evidence, and thus established the importance of such evidence in determining homology of structure. Indeed, it was the embryonic studies of his day that gave the most striking support to Geoffroy's idea of a single being appearing in the diverse figures of the animal kingdom. Johann Meckel, a German scientist studying embryonic development, had expressed the view, in 1811, that the embryonic stages of the 'higher' animals resembled the adult forms of the 'lower' animals. Karl Ernst von Baer made a spectacular advance in embryological studies when he discovered the mammalian egg in 1827, after which he turned his attention to the relations claimed by Meckel. But this work of von Baer produced a new aspect in the thirties, which reinterpreted the embryological similarities, and gave Huxley the ammunition he was to make use of in the fifties.

Von Baer's correction was the fact that the embryonic stages of the more complex species did not actually resemble the adult forms of the less complex, but rather the embroyonic forms of those animals. The resemblance was kept, therefore, to embryonic development. Von Baer then postulated his "biogenetic law," which consisted, in effect, of four main points:

(1) In development, general characters appear before special ones.

(2) From the more general characters are developed the less general and finally the special.

(3) In the course of development an animal of one species diverges continuously from one of another.

(4) A higher animal during development passes through stages which resemble stages in development of lower animals.

As the reader may see, Geoffroy's thesis still reflects the evidence. If, in all animals, special characteristics follow general during development, and thus species diverge more and more by this same process, then it would seem that the development of different species parallels, to some degree, the develment of different characteristics in a single animal. Watching the species diverge is akin to watching the special characteristics diverge in the individual, or like watching the development of a single being. But to Huxley's way of thinking, such evidence provided a means of rejecting Geoffroy's notion.

In 1854 Huxley gave a lecture entitled "On the common plan of animal forms" which began with reference to Goethe's essay in support of Geoffroy. (The lecture survives in notes only.) The lecturer proceeds to show what a common plan would mean by presenting Camper's drawings and noting that homologous forms may be seen to transform into one another by small increments. He then notes that such a method of transformation, which he calls "the insensible gradation of forms," was the sole method applied to structural analysis by Cuvier, and asks:

> is there any other method of ascertaining a community of plan beside the method of Gradation?[14]

The lecturer then turns to the methods of philology for examples. Here too one finds the method of gradation, done in terms of sound: we see the community of _unus_, _un_, _one_, _ein_, or _Hemp_, _Hennep_, _Hanf_, or again of _Cannabis_, _Canapa_, _Chanvre_. But although the meaning of _Hemp_ and _Cannabis_ is the same, is there any way of showing that the two _words_, as elements of language, are the same? Their sounds are obviously quite different.

> Nevertheless modern Philology demonstrates that the words are the same, by a reference to the independently ascertained laws of change and substitution for the letters of corresponding words, in the Indo-Germnic tongues; by showing in fact, that though these words are not the same, yet they are modifications by known developmental

laws of the same root.

Now von Bär has shown us that the study of development has a precisely similar bearing upon the question of the unity of organization of animals. He indicated, in his masterly essays published five-and-twenty years ago, that though the common plans of adult forms of the great classes are not identical, yet they start in the course of their development from the same point. And the whole tendency of modern research is to confirm this conclusion.

If then, with the advantage of the great lapse of time and progress of knowledge, we may presume to pronounce judgment where Cuvier and Geoffroy St. Hilaire were the litigants—it may be said that Geoffroy's inspiration was true, but his mode of working it out false. An insect is not a vertebrate animal, nor are its legs free ribs. A cuttlefish is not a vertebrate animal doubled up. But there was a period in the development of each when insect, cuttlefish, and vertebrate were indistinguishable and had a Common Plan.[15]

What is actually going on here? Geoffroy had spoken of an insect as a vertebrate with free ribs (one may imagine a centipede). He had called the os hyoidal 'the same' in all vertebrate skulls although Cuvier pointed out extreme differences in structure. But some commonality of structure, albeit a very general one, could indeed be recognized. How was the commonality to be accounted for? Evidently, as a transform of a common underlying plan. But the notion violated Cuvier's distinctions of type. Since von Baer had demonstrated that all types begin from relatively similar embryonic beginnings, and diverge later on, the problem was solved. The distant resemblance in adults was all that was left of the common general structure that had been visible in the embryos. Type distinctions, however, were made upon the plans which could be generalized in the adult forms, and thus separated forms whose only resemblance was found upon this level of extreme generality. Geoffroy was right: such resemblance was not a result of common function, but actually common structure, yet such a commonality, derived as it was from common embryonic beginnings, could hardly be called 'sameness.' Now let us turn to the 1858 lecture.

Since there is some commonality of form between the vertebrae and the skull bones (one can imagine reaching the latter by a continuous transformation of the former), Huxley must recognize this without granting that they are actually homologous. Such an admission would force him to ask in what sense these two very different structures could be 'the same,' the very sort of question that pushed minds into theorizing about some sort of abstract mediator. Huxley's strategy, as he turns from the question of the homology of the vertebrate skull to that of the possible homology of the vertebrae and the skull bones, will be to shift the ground of appeal away from the method of gradations and towards the study of embryonic development. He asks his audience to remember that there are _two_ methods of determining homology, that of gradations and that of developmental history. But, he says,

> to one, and to one only, can the ultimate appeal be made in the discussion of morphological questions. For seeing that living organisms not only _are_, but _become_, and that all their parts pass through a series of states before they reach their adult condition, it necessarily follows that it is impossible to say, that two parts are homologous or have the same morphological relations to the rest of the organism, unless we know, not only that there is no essential difference in these relations

> in the adult condition, but that there is no essential difference in the course by which they arrive at that condition. The study of gradations of structure presented by a series of living beings may have the utmost value in suggesting homologies, but the study of development alone can demonstrate them.[16]

The concept of homology is actually being reinterpreted here, and made to depend upon parallelism of development only. The developmental history of vertebrae is then compared to that of skulls, and while it is found that both begin from a common embryonic form, an early divergence in structure results in very different end products.
Summarizing, Huxley says:

> The fallacy involved in the vertebral theory of the skull is like that which, before von Bär, infested our notions of the relations between fishes and mammals. The mammal was imagined to be a modified fish, whereas in truth, fish and mammal start from a common point, and each follows its own road thence. So I conceive what the facts teach us is this:—the spinal column and the skull start from the same primitive condition—a common central plate with its laminae dorsals and ventrales—whence they immediately begin to diverge...
>
> Thus it may be right to say, that there is a primitive identity of structure between the spinal or vertebral column and the skull; but it is no more true that the adult skull is a modified vertebral column than it would be to affirm that the vertebral column is a modified skull.[17]

Huxley's point is, I take it, that the skull bones and the vertebrae differ too greatly in structure to be called homologous, by which he means something like 'one is not a modification of the other.' He did not, of course, really need the developmental history to show those differences in structure, since as he says himself, they become greater as the organism grows older, and are at their most extreme in the adult forms. His reason for bringing in the developmental evidence is not to establish differences as much as to secure a principle. He wants to argue, as I have already indicated, that the distant structural similarities that drew Geoffroy's attention led to such claims as 'the mammal is a modified fish' and 'both the mammal and the fish are modifications of the same archetype.' The embryonic evidence shows us, however, that the first of these is simply an error, and the second a mixture of truth with error. This latter confusion results through the postulation of an abstract 'something' which mediates between the distantly related forms in order to 'explain' how the forms *are* related. While it is true, Huxley says, that they are similar, the observer who looks no further is misled into an attempt to explain what he has seen from the similar forms themselves, when he should be looking into their generation. Naturally, while one has the forms before the eye, it seems that something is mediating between them. The mistake however, consists in making this mediating element contemporary with forms themselves, when it is actually removed *in time*. That is, the actual 'common element' is the common embryonic form from which both organisms begin their development.

At this point in theoretical development such a reinterpretation of homology seems to be arising out of a resistance to the 'ideal notions' of *Naturphilosophie*, but something more is happening than appears on the surface. The introduction of _time_, of history, is not simply a reaction against Owen but rather a new impetus in biology. In the year following Huxley's 1858 lecture Darwin would publish his _Origin of Species_ and put biology upon a historical footing. Huxley had been debating this question with Darwin and their mutual friends since 1856, at which time Lyell mentions that Huxley was willing, for the sake of the argument, to lean a long way towards Lamarkian developmental theory. As was the case on the continent, history, or more particularly, developmental history, was becoming the basis of a new awareness.

Darwin's thesis will get rid of the archetype (which is beginning to look a-historical as well as immaterial) in a manner similar to that proposed by Huxley, but he will go that man one better. He will find the 'common element' in a common ancestor, and develop the species itself _in time_ even as the individual is developed. Morphology will become the history of species development, or as it is now termed, phylogenetic morphology (Greek _phylon_--'race'). And because this scheme will allow him to speak of the development of species without reference to anything 'ideal,' or spiritual, he will look, to some, to be the 'Newton of the grass-blades' that Kant was sure would never arrive.

But not all questions have been answered as yet. We should like, in particular, an analysis of von Jaeger's criticism and Huxley's answer. Does the projection of the figurative 'movement' of transformation into history make it real? Is

Huxley past this rather difficult roadblock?

(c) From Darwin's first edition to the triumph of phylogenetic morphology

No answer to the question formulated in the last section may be found in subsequent biology. Darwin published the first edition of The Origin of Species a year after the Huxley lecture on the theory of the vertebrate skull, and from that point forward morphology took a chronological focus. The debate centered on whether species were actually related by blood, and the question of their formal morphological relations was subsumed under the question of descent. This attitude, which finds no significance in morphological studies other than their contribution toward theory of descent is still the prominent one today. We find it, for example, in Julian Huxley's summation of the revolution which Darwinism precipitated in morphological taxonomy:

> we can...trace the abandonment of purely artificial systems for those based upon general likeness. Still later, as it was realized that superficial resemblance (as between a porpoise and a true fish) may mask basic difference, we may see the substitutions of likeness in fundamental structural plan as chief criterion, in place of mere superficial likeness. Pre-Darwinian nineteenth-century classification, as practised by Goethe, Cuvier, Oken, Owen, T. H. Huxley, etc., worked on this assumption.
>
> But although this method, at least for larger groups, was identical with that practised in the latter half of the century, it lacked any real theoretical basis grounded in biological justification. The analytic but less speculatively minded, like Huxley, simply assumed that structural homology (or common archetypal plan) was

> the right key to unlock classificatory secrets: the idea that it was right because it implied genetic relationship did not enter their minds, or at least was not allowed to enter their conscious minds, until after the publication of Darwin's Origin in 1859. The more theoretically-inclined, such as Goethe and Oken, regarded the existence of structural plans common to a large number of animals as evidence of some form of planning in creation. In extreme form, this theoretical view found the basis of homology in the existence of a limited number of archetypal ideas in the mind of the Creator. [The attribution of such crude teleological judgment to Goethe, who praised Kant's third Critique for getting rid of it, is evidence of the bad scholarship which is typical when we turn to works on Goethe's scientific interests.]
>
> With the coming of the Darwinian epoch, however, all this was changed. Homology, instead of being essentially a descriptive term implying nothing more than the sharing of a common archetypal plan, became an explanatory term implying the sharing of a common plan on account of descent from a common ancestor. The basis of classification became, in theory at least, phylogenetic. Degree of resemblance was taken as an index of closeness of relationship, and taxonomic categories were defined on the assumption that each represented a branch of higher or lower order on a phylogenetic tree.[18]

Such is the change from pre-Darwinian to modern morphology, but this description raises problems.

What do we imply of structural homology when we say that it was correct only because "it implied genetic relationship"? If the investigator may recognize and confirm a law within the phenomenal appearances themselves, what need is there for any further 'justification?' (Newton's famous "Hypotheses non fingo" applies to such work of his as is devoted to the discovery of the how of the phenomena, or the law. If we have found the law of gravity within the phenomena, we need not look hypothetically behind these phenomena for a why which will 'justify' our law. Speculation on 'etherial fluids' is totally hypothetical, and Newton left it, for the most part, to others who cared for such things.) The author of the quote above must be assuming that structural homology is not an empiric fact, a law within the phenomena, but rather an interpretation of the same. Even so, when T. H. Huxley offered that the method of gradations could but 'suggest' what only developmental history could prove, he was moving in the same direction. The 'movement' of forms becomes a mere 'suggestion' whose worth is as yet undetermined, and the 'fact' of real import becomes ontogenetic history. Julian Huxley's parallel is obvious: the evidence of gradation (structural homology in the old sense) is taken as a hypothetical interpretation which must be 'justified' through the discovery of genetic relation, or phylogenetic history. This latter is the biological 'fact,' while the structural relations are something less.

This distinction does not seem to be maintained by Darwin. We must remember that his thesis postulated the evolution of species by divergence from ancestral root forms, which divergence was imagined to proceed by very small steps. He argues, in the *Origin*, that although we cannot now find all these steps in the geological record, this fact does not tell against his theory due to the extreme imperfection of that record. We can, even with but the token sampling of earlier life forms preserved by fossilization, imagine what the intermediate steps could have been like.

In order that the reader understand what is meant by this last demand, Darwin must give some directions as to what he desires of the imagination:

> In the first place it should always be borne in mind what sort of intermediate forms must, on my theory, have formerly existed. I have found it difficult, when looking at any two species, to avoid picturing to myself, forms directly intermediate between them. [as was done in Camper's drawings] But this is a wholly false view; we should always look for forms intermediate between each species and a common but unknown progenitor; and the progenitor will generally have differed in some respects from all its modified descendants.[19]

Thus we must not look, when faced with two similar existent species, for fossil forms directly intermediate between them, but rather for two lines of intermediate forms, one for each, and both leading to a single ancestor. But how do we picture these intermediates? Exactly as we would have pictured those directly intermediate between the two existent species, the only change being that we now connect, not the two existent species, but a fossil form and an existent one. That is, we imagine a continuous graded series even as Camper did, and theorize that evolution takes place in just such a series.

We may obtain a more vivid picture from Darwin's discussion of morphology (which he terms the "very soul" of natural history). Here we find him attempting to bring forth his argument from purely structural considerations:

> What can be more curious than that the hand of a man, formed for grasping, that of a mole for digging, the leg of a horse, the paddle of the propoise, and the wing of a bat, should all be

> constructed on the same pattern, and should include the same bone, in the same relative positions? Geoffroy St. Hilaire has insisted strongly on the high importance of relative connexion in homologous organs: the parts may change to almost any extent in form and size, and yet they always remain connected together in the same order. We never find, for instance, the bones of the arm and forearm, or of the thigh and leg, transposed. Hence the same names can be given to homologous bones in widely different animals. We see the same great law in the construction of the mouths of insects: what can be more different than the immensely long spiral probiscus 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 different purposes, are formed by infinitely numerous modifications of an upper lip, mandibles, and two pairs of maxillae. Analogous laws govern the mouths and limbs of crustaceans. So it is with the flowers of plants.[20]

All such relations, obviously those of a structural homology detectable by gradations, are given here as empiric fact. When Darwin searches for the causes of such 'facts,' he quickly rejects the doctrine of final causes or that of an intelligent creator and concludes:

> The explanation is manifest on the theory of natural selection of successive slight modifications,—each modification being profitable in some way to the modified form, but often affecting by correlation of growth other parts of the organism... If we suppose that the ancient progenitor, the archetype as it may be called...had its limbs constructed on the existing general pattern, for whatever purpose they served, we can at once perceive the plain signification of the homologous construction of the limbs throughout the whole class.[21]
>
> Naturalists frequently speak of the skull as formed of metamorphosed vertebrae: the jaws of crabs as metamorphosed legs; the stamens and pistils of flowers as metamorphosed leaves; but it would in these cases probably be more correct, as Professor Huxley has remarked, to speak of both

> skull and vertebrae, both jaws and legs, &c.,—as having been metamorphosed, not from one another, but from some common element. Naturalists, however, use such language only in a metaphorical sense: they are far from meaning that during the long course of descent, primordial organs of any kind—vertebrae in the one case and legs in the other—have actually been modified into skulls and jaws. Yet <u>so strong is the appearance</u> of a modification of this nature having occurred, that naturalists can hardly avoid employing language having this plain signification. On my view these terms may be used literally; and the wonderful fact of the jaws, for instance, of a crab retaining numerous characters, which they would probably have retained through inheritance, if they had really been metamorphosed during a long course of descent from true legs, or from some simple appendage, is explained.[22] [italics mine]

The "appearance" that Darwin finds so compelling above is <u>not</u> that of "a modification of this nature having occurred" (since this would indeed be an interpretive hypothesis) but the 'movement' directly between forms (i.e., between legs and jaws). Darwin himself admits that he takes the figurative language of 'metamorphosis' literally, and presents, as his ground for doing this, the argument that the <u>appearances are compelling</u>! 'Movement' is therefore weighted as if it were an empiric fact, and the transformation it suggests is projected back in time, where it is unfortunately non-phenomenal except in such cases as may be traced, by future work, within the fossil record itself. But even if we may find a graded series within that record, what would such evidence demonstrate? The 'movement' of such a series would still be imagined rather than physically real, and we should still have to ignore von Jaeger's warning in order to take the metaphoric literally.

Of course, when one attempts to 'read' the fossil record, structural homology may well prove the most important tool available. We have little more presented to us here but the remains of ossified structures and (hopefully) a date to go with them. Thus, when the first 'lines of descent' were traced, during the ten years that followed the publication of the Origin, they were based upon the pre-Darwinian notion of structural homology plus the Darwinian projection of the 'movement' therein as history. There can be little doubt, at this point, that the method of gradations is the tool of the investigator. We find, for example, T. H. Huxley himself, in an 1876 lecture, pointing to the series of forms of Fig. 1, Plate XV, and arguing:

> This evidence is conclusive as far as the fact of evolution is concerned, for it is preposterous to assume that each member of this perfect series of forms has been specially created; and if it can be proved—as the facts adduced above certainly do prove—that a complication animal like the horse may have arisen by gradual modification of a lower and less specialized form, there is surely no reason to think that other animals have arisen in a different way.[23]

The "facts adduced above" are the structures shown on Plate XV, which evidence is surely nothing more than Owen's notion of homology. The very man who once argued that only developmental history could prove homology is now arguing that homology proves developmental history (since the only developmental history he can have for the fossil forms is the phylogenetic one he constructs upon the basis of the evidence of gradations).

His argument is, of course, mistaken, even if we take the 'movement' to be factual evidence as we are asked to do, for it commits the fallacy of assuming that the named alternative is the only one; but we must return to our present concern. The crucial thing is this: the evidence of the method of gradations, the 'movement' that von Jaeger termed merely figurative, must be taken by the phylogenetic investigator as factual.

This situation was noted by Emanuel Radl in his very fine History of Biological Theories when he pointed out that phylogenetic morphology seemed to change the meaning of 'homology' without altering the method of detection. Taking the example of Ernst Haeckel, who was the foremost exponent of Darwinism in Germany in the latter half of the century and whose tireless morphological study drew high praise from Darwin, Radl writes:

> Homologous organs, Haeckel said, were, according to the earlier view, merely those which were similar in structure, while analogous organs had similar functions. Now, he claimed, we look upon homologous organs as those which are descended from a common ancestral organ, while analogous organs represent similar adaptations to a common environment. But how does he recognize these blood-relationships, these inherited and adaptive structures? Simply by comparative methods, just as formerly similarities, homologies, and analogies were recognized.[24]

Huxley's attack upon the authority of the method of gradation, it would seem, was quite short-lived and probably not very seriously meant to begin with. The target was Owen and his 'ideal notions,' not comparative method.

That the phylogenetic morphology introduced by the Darwinian revolution could not represent a departure from the older "idealistic morphology" of the first half of the century was also the conclusion of a monograph upon this very question by Adolf Naef (written at the University of Zurich, 1919) entitled Idealistic and Phylogenetic Morphology: Towards a Methodology for Systematic Morphology. Noting that Darwin, Huxley, Haeckel and others formed the new phylogenetic categories by simply re-interpreting the "idealistic" ones, such that the form-relation of the former became the blood-relation of the latter, metamorphoses became evolution, type became phylum, and so on, he writes:

> It has been said—and was by Darwin—that the demonstration of the ideal "Plan" after which related beings are supposedly constructed cannot constitute a scientific explanation. We may not deny that the theory of evolution and the phylogenetic built upon it is, in many cases, more suited to the conduct of science than the approach of idealistic morphology. But since that theory of descent arises out of the study of ideal relations and is grounded upon the natural system which results from this, it must be admitted at the outset that every deepening of idealistic morphology will draw after it a corresponding advance in descent theory. It has not yet been shown, moreover, how one may proceed logically in phylogenetic morphology without referring back to idealistic morphology.[25]

and concludes:

> Since it defined the natural system of organisms idealistic morphology is not only the pre-condition for the introduction of phylogenetic in the history of the science but is still the logical basis for the same. (After all, we cannot search for things which are no longer in existence without any

previous suppositions.)[26]

Ernst Cassirer, writing in 1940, called Naef's presentation a clear exposition of "the originality and methodological justification of idealistic morphology."[27] The present writer can see no reason why this judgment should not hold true today. To my knowledge, the basis of modern morphological taxonomy is still the natural system which began with Cuvier and was further developed by men like Geoffroy and Owen. Metamorphosis, type, and archetype, were terms which denoted the form relations that still constitute the fundamental language of any morphology.

Indeed, there is some indication that biological theory is beginning to grow sensitive to the issues raised in Naef's monograph. (The writings of Lancelot Law Whyte in England and Adolf Portmann in Germany seem to indicate this sort of concern.) Agnes Arber, who was, until her recent death, one of the foremost botanical morphologists writing in English, saw the trend toward recognition of the underlying idealistic morphology within phylogenetic morphology as a necessary one, welcoming it with the hope that it would lead to a liberation of mind and a deepening of theory. The concept of liberation here is interesting. Arber felt that biological thinking suffered a sort of imprisonment by being materialized, by turning from the actual relations of form which were the morphologist's first concern to the physical theory of descent pinned upon them. She pointed out that this tendency was so powerful that it became impossible, within Darwinian modes of thought, to understand the idealistic concepts which had under-written the phylogenetic ones:

> In the period that opened with the publication of The Origin of Species, the scientific world became convinced, both that evolution had taken place, and also that the natural selection of chance variations provided a master key to the understanding of this process. Up to that time plant forms had been considered worthy of study in and of themselves, and where relations between these forms were recognized, this relation was treated as logical rather than temporal. In the Darwinian reorientation of biology, however, the attention of most botanists was diverted from pure morphology to the use of form data in support of speculations about evolution. This was particularly so where flowering plants were concerned, since the most direct kind of evidence, that of the geological record, was rarely available. To evolutionary schemes, the type concept fell an immediate victim... To many workers of the time, the diversion of biology into historical channels was a welcome relief, since it transformed theoretical botany into something material, amenable to picture-thinking, and not demanding difficult mental activity of a metaphysical kind. Thus, by a feat of legerdemain, which seems to have passed almost unnoticed, the Ancestral Plant was substituted for the Archetypal Plant, and those characters which had, with reason, been attributed to the mental conception of the archetype, were, without further justification, assumed to have been proved for an actual historically existent ancestor.[28]

(This process began with Darwin's treatment of morphology in the Origin. Many examples of the attribution of type characteristics to original progenitors may be found there, and other writers followed the example.)

Confusion between the type and the progenitor obscures not only the actual relations of form which were under examination in the earlier morphology, but also the unsolved problems of that science. When Darwin took the progenitor to be a sort of hypostatization of the type, he lost sight of the unanswered questions surrounding the notion of organic typicality, and commited phylogenetic morphology to an unreflective path. The type is presupposed by phylogenetic studies, but the presupposition is beyond investigation and therefore not capable of clarification. In order to perform such clarification, one must return to the form per se, and attempt to understand what is meant by typical form. This is an undertaking that can be forwarded only on the ground of the older idealistic morphology, and from it alone can come the answers that will finally measure Cuvier's work against that of Geoffroy, and Goethean biology against the modern.

(d) Summary and some conclusions

Goethe's resistance to Linnaean taxonomy is symptomatic of the development of biological thought in his day. The seminal notion of the development is the shift in the attention of the investigator from static form to 'movement,' but while Goethe provides a very clear picture of the shift and the reasons for it, the outlines of the problem are not so obvious elsewhere. It was this very aspect, the exchange of stasis for 'movement,' which has remained problematic since. Considering that it is, however, the basis of the post-Linnaean natural system, it is also a fundamental ground for present organics, and any lack of clarity in regard to it renders the entirety of this structure questionable.

That a lack of clarity does indeed exist should be evident by this point, but it may help to present one more example, a sort of paradigm case, before concluding. Near the end of his life, Thomas Huxley was asked to estimate Owen's contribution to anatomical science for a biography of Richard Owen (who had passed away some years earlier). Huxley produced a small essay, carefully written and condensed, in which he attempted to review, in a nutshell as it were, the development of modern organics. He found it necessary to estimate the contribution of Goethe as well, and to pass judgment upon the meaning of the shift to 'movement.' He wrote:

> The science of development, in the modern acceptation of the term, came into existence when Wolff Casper Friedrich Wolff, 1733-1794 demonstrated the fallacy of the emboitement theory; and also proved that the leaves, the petals, the stamens, and so forth, of flowering plants do, as a matter of fact, become differentiated as they grow. It was thus that, thirty years before Goethe saw how the relations of living forms could be ideally represented, Wolff proved what they in fact are. In quite another sense from that of Goethe's reply to Schiller, the embryologist showed cause for the belief that 'unity of organization' is not an idea, but a fact.[29]

The evidence that Wolff had before him is presented in Fig. 2, Plate XV. Here we see the embryonic form, growth stages, and adult leaves of the stem phase of Lapsana communis (Wolff investigated the development of all appendages, but for our purposes the leaf-series of the stem is enough). The outer ring presents, in ascending order clockwise, the adult forms. The arcs emerging counter-clockwise from a common origin trace the growth stages of each individual leaf, and at that common origin we see the embryonic form which is the same for all. The picture provides an immediate refutation of the hypothesis that the final stage was already formed, in miniature, in the embryo. Let us ask, however, what it holds for the conversation between Goethe and Schiller.

The point of Goethe's thesis may be seen in the 'movement' of the adult stages. They form a serial homology or metamorphic series, and as members of such a series, may be called isomorphs of a continuous metamorphosis. Or at least, as Darwin remarked, so matters <u>appear</u>. Does the present evidence 'explain' this appearance? It does give us a knowledge of the manner in which the natural process <u>begins</u>, but it would seem to tell us very little about how that process continues, that is, about the nature of the process itself.

Let us look, for instance, at Fig. 3. I have drawn, by free imagination, a metamorphic series which begins with the common embryonic form of Fig. 2 and continues to produce a form which has no relation to the other shapes of Fig. 2 <u>other than the starting point</u> of the development. It is, therefore, homologous with any of the stages presented in Fig. 2 if we trace its 'movement' <u>back through the embryonic form</u> and thence outward to the form chosen. But surely this is not a very interesting relationship; not a very meaningful one for the morphologist. Yet the relation determined by the commonality of the origin is really nothing more. The adult stages of Fig. 2 'move' directly into one another in their immediate appearance. No addition of a common embryo is needed to see this. When such evidence is added, however, we see that we can also trace a 'movement' back through the growth stages of any leaf to a common point and then out again to another leaf. But what is the worth of this when we are faced with Schiller's objection to the 'movement' of the outer ring? It is exactly nil.

Should the reader think that I have taken undue liberties with my free drawing, in that I have not followed the rib and vein pattern which is common to all of the adult leaves, we may actually derive the same example, now that the principle of contention is clear, from Fig. 2 alone. (I am not sure that the criticism should be granted cogency anyway, seeing that this rib and vein pattern is not developed in the early embryo.) As I remarked above, the arcs trace actual developmental stages of the individual leaves. The radii, however, trace another relation which we might call 'hypothetical growth stages.' These are forms which, when arranged in a series from the embryo to the adult stage, proceed in relatively linear order, growing somewhat in the manner that crystals grow, taking on a basic configuration quite early and then simply enlarging upon that theme. But when we turn from their example back to the actual growth lines, we see that this growth by no means follows such a simple expectation. The highly developed articulations of the silhouette of early forms of the second adult leaf from the left, for example (the 'points' on the edge), are lost in the adult stage. The actual series of growth forms seems to go through stages of form which are not at all in evidence in the final result. The plant discards many of its earlier articulations in arriving at its adult conclusions. Can this procedure, a developmental process that seems to go quite far from the final mark before getting 'back into line' in order to hit it, be in any way illumined by Wolff's evidence? What help is a common embryo here when the plant will vary its departure from that simple beginning?

Actually, the whole suggestion was wrong-minded from the beginning. As Goethe pointed out, one cannot give precedence to one form in a homologous series and make the rest subservient. We might as well call a foliage-leaf a metamorphosed sepal, as go the other way and term the sepal a metamorphosed foliage-leaf. The 'movement' runs in either direction, and is quite reversible. Huxley and Darwin were captivated by the obvious fact that the simplest forms tend to come first <u>chronologically</u>. But from the simple form we may not predict the characteristics of later growth. This should have been foremost in their minds. Only the growth as a whole, all the stages held in the mind together, shows us what is typical of the organism. Once we have seen this whole, we can <u>then</u> understand the earliest and simplest forms as the simplest representations of this type. These simple forms, however, show us the <u>least</u> of any of the stages, because they are the least developed. The embryonic form can be perfectly identical for so many later variations just because it is itself so impoverished in regard to form, and therefore, in a certain sense, the <u>least</u> typical of the organism. To look to it for help in understanding homology, particularly general homology (homology to type), is to move in the wrong direction.

It would seem that, contrary to Huxley's conclusion, the manner in which "the relations of living forms could be ideally represented" cannot be profitably dismissed. Wolff's evidence does not allow us to discard Goethe's work, for it cannot cover the same ground. Even so, Darwin's contribution does not 'explain' homology or type, but accepts these notions and builds a new structure upon their foundation. Huxley's attempt to reduce the type concept to a common originating form was evidently based upon his inability to come to terms with the demands of his own science. He, like any other morphologist, was indeed quite dependent upon the manner in which living forms could be "ideally related," but he found this possibility quite distressing and believed that he had escaped it. Biology has proceeded ever since as if this were true; the illusion is, even today, quite popular.

The truth of the matter is, however, that paleontology and therefore evolutionary theory may not be divorced from those relations that Huxley termed "ideal." The unifying 'movement' of homology, though it may seem an 'occult quality,' is the foundation of any morphology, whether idealistic or phylogenetic. Once this is recognized, Goethe's work may be returned to its rightful position in the history of biology. It was not an aberrant branch, but part of the central stem, and its problems were fundamental.

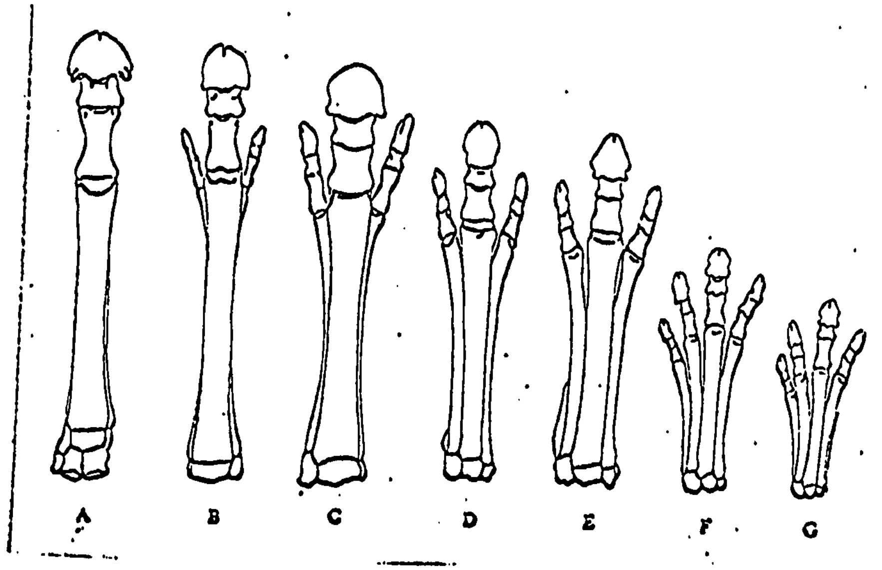


Fig. 1

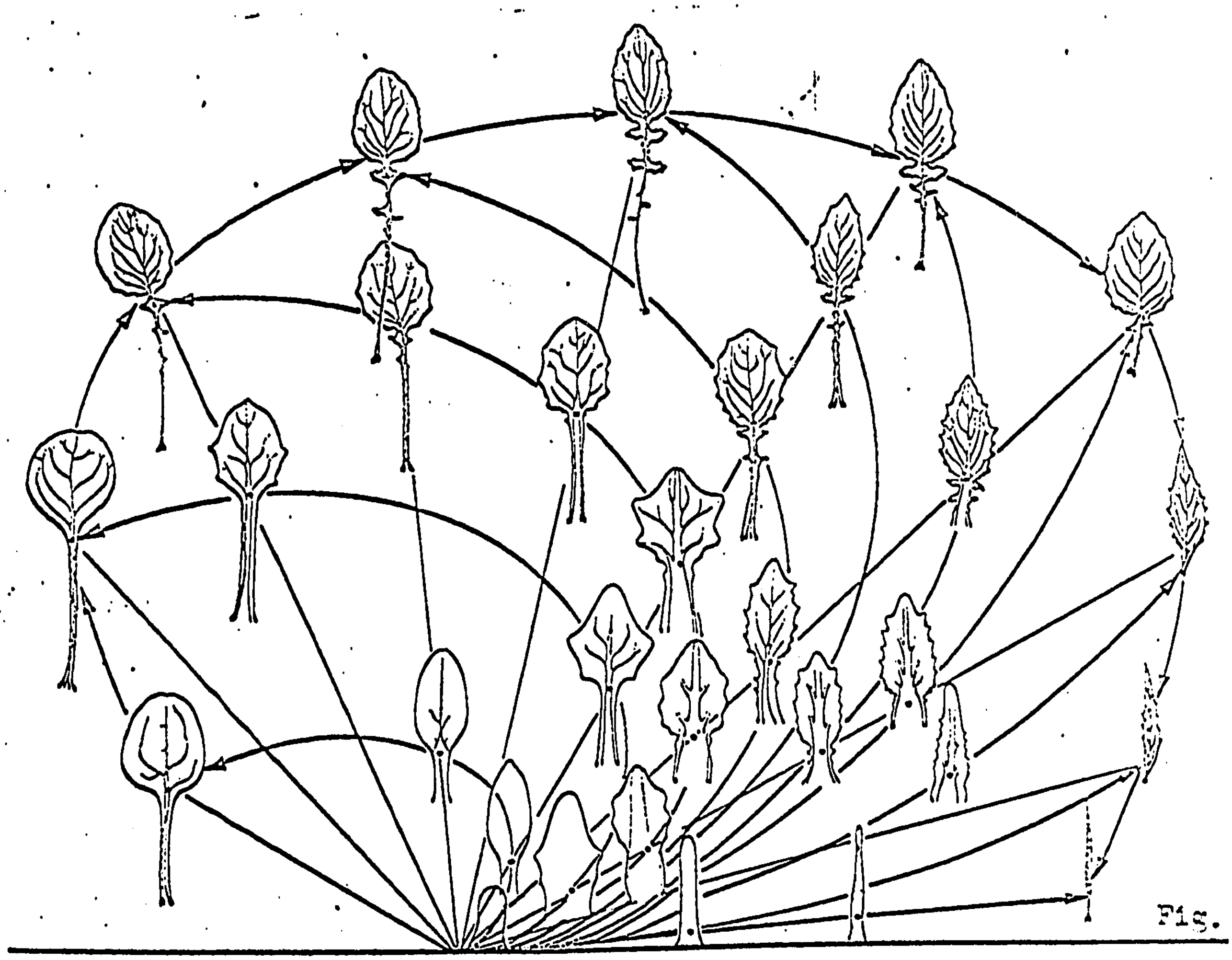


Fig. 2

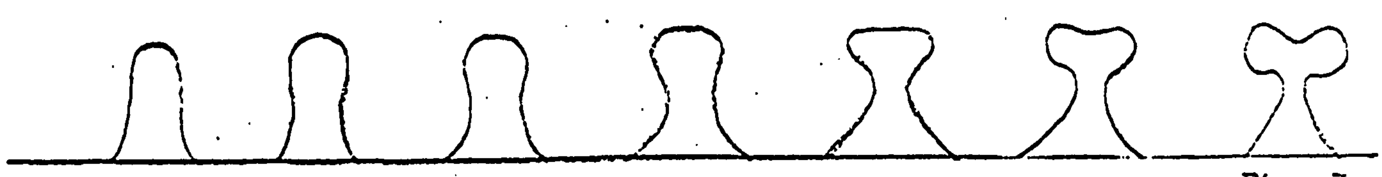


Fig. 3

III The Problem of Type

The great advance of biology from the artificial to the natural type brought with it the responsibility of a new way of thinking, which is something very different from a new set of thoughts. Organic typicality was now based upon the 'movement' of homology, and thus upon dynamic rather than static criteria. On the one hand, this notion was clear enough to found a natural system of classification which has survived, at least in principle, to this day; but on the other, it was problematic enough to give rise to such difficult questions (like those of Schiller and von Jaeger) that many investogators, as Agnes Arber noted, felt the shift away from direct considerations of typicality to those of physical history to be a welcome relief from "difficult mental activity of a metaphysical kind." But since this shift provided no answers to the earlier questions, and no better understanding of the concept of typicality, the relief was illusory.

While reviewing the history of the period between the death of Linnaeus and the ascent of Darwinism, the reader may have the sense that he is witnessing a sort of failure of nerve. Things begin well enough with the advance from Linnaean classification to that of common structural plan, but there follows a period of wavering (after the debate between Cuvier and Geoffroy, during which rather serious questions regarding the implications of the new methodology arose), and when the new biology seems to consolidate and clarify (in the 1860s), it does so upon a basis which represents, in a certain sense, a return to the past. As we have seen, Linnaean taxonomy failed through its inability to deal with the nature of organic form. Its terminology applied only to static figures, quite recognizable, but not actually fixed in the organism itself. The recognition of the unfixed nature of organic forms led to the perception of continuity, through transformation, where identification by static shape could find only discontinuity. Yet once this new natural system was established, Darwin was able, while making use of the system and the comparative methods by which it was developed, to effect a quiet return to the notions of empiric evidence and factuality that prevailed before the new biology. One would have expected, on the contrary, that a consolidation of the advances of biological methodology would have led to a new epistemology as well.

When Darwin spoke of taking metaphoric language literally, he indicated what he obviously took to be a solution to the question of the actual signification of such terms as 'transformation' and 'metamorphosis' within empirical description. This terminology had been problematic for earlier morphology, for, as von Jaeger noted, it could not refer to physical events (the foliage-leaf does not change into a sepal, nor a bat's wing into a human hand), and yet it was coined to describe the actual appearance of homologous forms (an appearance which Darwin himself found 'compelling'). But although Darwin may have been quite correct in his hypothesis that distinct species could have common ancestors, organisms which are not now in existence, and which, if they were, would seem quite distinct from the present forms, cannot explain how the observer is able to <u>see</u> 'movement' immediately between these present forms. After all, the understanding that the observer may, if he likes, imagine a graded series of forms between, say, any two differing triangles, is not to be explained by the discovery of a 'common ancestor' between the two object triangles, but rather a common plan. Even if there were a common ancestor, it would not be present, in the present forms, except as a plan (which plan it would share). But the moment we reduce Darwin's thesis to the notion of a common plan, we are right back where we started. What is the common element? It cannot be the ancestral organism, for as we have just noted, in order that this form be in any way part of present forms, it must share some common formal structure with them (since it could hardly be said to be physically present). And what can we mean by 'common structure'?

This is essentially the question posed by Huxley in the following passage (also quoted in the last chapter):

> how can the intelligent student of the human frame consider the backbone, with its numerous joints or vertebrae, and consider the gradual modification which these undergo...Without the notion of a vertebra in the abstract, as it were, gradually dawning on his mind; the conception of an ideal something which shall be a sort of mean between the actual forms, each of which may then be conceived as a modification of the abstract or typical vertebra?[1] [italics mine]

The reader will remember that Huxley was to answer this question, which is a very good one, with the suggestion of a common ontogeny, just the sort of answer which led back to the question by leading back to commonality of plan. Huxley began his studies under the powerful influence of Owen, and thus it is probably his own development he is describing here. The result is an abstract or schematic vertebra, a notion that Owen actually commited to drawings. But Huxley, dissatisfied with this result, goes on to search for a material representative of this abstract mediator. It is interesting to read that Agnes Arber, in attempting to understand like developments, attributed both the abstract schema and the ontogenetic or phylogenetic primal-form to the same impulse towards the physical and tangible. She characterizes such thinking as 'picture-thinking,' and sees behind this an urge to grasp by seeing with the physical eye. Thus we get the schematic drawing, which attempts to present a general form. But with the rise of Darwinism, the "inclination to give the archetype visible and tangible expression" was transformed, taking, from that time onward, the "subtler and hence more insidious form" of a materialized schema, the original progenitor.[2] Since Huxley admits that the basis of his approach is the notion of "an ideal something which shall be a sort of mean between the actual forms," by which he means the "typical vertebra" (schematic), Arber's analysis fits quite admirably.

Arber has, however, mis-named the problem when she calls it 'picture-thinking.' The failure of the schema was due to the fact that, since it was itself an individual form, it could not take precedence over the other forms of a homologous series, nor mediate between them. If it fit into the series at all, it would fit into a particular position, just like the rest of the individual members. If, as is more likely, it was too geometrically abstract to fit into the actual series (an example of this would be Owen's typical vertebra[3]), it represents no more than an expression of general propositions in schematic form. It may show us what every vertebra possesses, in general structure, but it does not explain how the many variations of form present in the vertebral column can give such a strong impression of unity, of being but 'modifications' of the same identity. It is not the invisible mediator between forms, since it has little to do with the 'movement,' between the same, that seems to unify them. But this 'movement,' while not a physical event, is still a _pictorial_ quality, found in appearances. If the schema has failed, this is not due to its pictorial quality but to its _stasis_; it is only one static form among others, but the same 'movement' may run through all. The real opposition here is between the static image and the dynamic one; the fixed and the changing. Both the abstract schema and the original progenitor are fixed entities, and thus their inability to serve as a _type_ concept (i.e., as that element which unifies several distinct forms, making them all 'familiar' instances of one identity).

We are brought once again to the problem of the seeming 'movement' of homologous forms, and the significance of this. Darwin rested his notion of phylogenetic development on this very movement, making the metaphoric into the literal, as he said, but it was just this sort of hypothesis that von Jaeger thought merely speculative. We do not _see_ the historical development that Darwin postulates in the phenomena themselves. It must be hypothetically added. One may so hypothesize if he likes, but must remember that his hypothesis is not grounded in empiric demonstration; is never, in _any_ sense, perceived in the appearances. Most emphatically he should not, as Darwin did, think that his hypothesis, which refers to material reality, is somehow seen in appearances which cannot be termed material facts. The 'movement' of homologous forms is not a physical event, nor does it entail any material transformation. All this language of _metamorphosis_ and _transformation_ is figurative language, not to be confused with empiric fact. But what then, does such language signify, seeing that it was formulated in response to the actual 'seeming' of the appearances? Perhaps in unraveling the tangled themes of von Jaeger's criticism we may come to an answer to this question.

(a) Language: the figure and the figured

Von Jaeger's criticism is powerful simply because it recognizes an obvious truth: the language of post-Linnaean morphology is heavily figurative (remember Darwin's remarks on his intention to take that figurative language literally— p.175 above. Goethe had never indicated that his language was anything else. He attempted to form his speech after the phenomena, like a poet, and this naturally leads to figurative usage. But von Jaeger, in a spirit quite opposed to that of Goethe, adds that figurative usage must fall short of empiric fact. I must part company with him.

Let us remember that the basic question is not whether Goethe's words are figurative, but whether they are empiric description as well. This question goes beyond considerations of language, but begins with them for the general opinion of our culture seems to deny denotative 'truth' to figurative speech, merely because it is figurative. A figure of speech does not have an immediate denotation, but makes its meaning by subterfuge, as it were, often by speaking of one thing in terms of another (such as the relation of a number of static forms to each other in terms of a movement which is obviously not present). So ubiquitous is the feeling that 'poetic <u>license</u>' is really the whole trick of poetic writing, it often seems enough to point out that a passage was 'poetic' or 'metaphoric' in order to dismiss it as lacking any truth claim. Actual poetry need not, of course, make such a claim, but that does not mean that figurative speech is incapable of doing so.

Oddly enough, the figurative use of language that is so easily condemned today as 'unscientific' has, in the past, been a major support to the progress of science, and while poets may be the chief source of the introduction of figurative usage into the language, scientists have certainly contributed their share. This fact is, unfortunately, generally overlooked.

In order to come to an understanding of the manner in which figurative speech is constantly being introduced into science, it is necessary to understand the manner in which it is introduced into the language in general, and therefore a small review of some philological points would not be out of place here. C. S. Lewis, in his <u>Studies in Words</u>, attempted to lay a basis for such an understanding by calling attention to the distinction between the "word's meaning" (the normal or customary usage that we may find in the dictionary), and the "speaker's meaning" (the <u>intention</u> of the individual user). He wrote:

> 'When I spoke of supper after the theater, I meant by <u>supper</u> a biscuit and a cup of cocoa. But my friend meant by <u>supper</u> something like a cold bird and a bottle of wine. In this situation both

> parties might well have agreed on the lexical (or 'dictionary') meaning of supper; perhaps 'a supernumerary meal which, if taken at all, is the last meal before bed'. In another way they 'meant' different things by it.[4]

The difference here is minor, but we recognize at once that it is omni-present in all linguistic usage. It can be larger, and the importance of this situation may be seen, says Lewis, from the fact that

> If some speaker's meaning becomes very common it will in the end establish itself as one of the word's meanings; this is one of the ways in which semantic ramification comes about.
>
> For thousands of Englishmen today the word furniture has only one sense— a (not very easily definable) class of domestic movables. And doubtless many people, if they should read Berkeley's 'all the choir of heaven and furniture of earth,' would take this use of furniture to be a metaphorical application of the sense they know— that which is to earth as tables and chairs and so forth are to a house. Even those who know the larger meaning of the word (whatever 'furnishes' in the sense of stocking, equipping, or replenishing) would certainly admit 'domestic movables' as one of its senses...But it must have become one of the word's meanings by being a very common speaker's meaning. Men who said 'my furniture' were often in fact, within that context, referring to domestic movables. The word did not yet mean that; they meant it. When I say 'Take away this rubbish' I usually 'mean' these piles of old newspapers, magazines, and Christmas cards. That is not what the word rubbish means. But if a sufficiently large number of people shared my distaste for that sort of litter, and applied the word rubbish to it often enough, the word might come to have this as one of its senses. So with furniture, which, from being a speaker's meaning, has established itself so firmly as one of the word's meanings that it has ousted all the others in popular speech.[5]

By such a process, the 'customary usage' is continually evolved.

Lewis has picked the smallest sort of change, the cooption of a term by one of its originally minor speaker's meanings. Certainly the modern 'furniture' <u>means</u> a good deal less than the older word, which was derived from the general verb: <u>to furnish</u>, i.e., to supply, equip. Today that verb is no longer general but specific, since when we say we mean to furnish a house, this is taken as the intention to put furniture (modern sense) within it, rather than to equip it with whatever was necessary (including perhaps, the plumbing and the windows). How great the change may be is estimable from the odd feeling we now get from the 17th century compliment "His mind bore a noble furniture of Divine Learning." The modern term is but a shrunken part of the older one.

But shrinkage due to habit, or even habitual linguistic laziness, is, as I said, the smallest sort of change. Other changes are more radical, and one of the most interesting is the expansion, rather than shrinkage, of a word's meaning. This takes place when a speaker's meaning which is figurative, which adds another level to the 'customary' usage, is generally adopted. Poets may have a good deal to do with this continual addition of new meanings. Shakespeare, for example, seems a likely suspect, since more 'new' meanings (new for Elizabethan England) which have since become customary are found, for the first time, in his plays than in the work of any other single writer of English. But scientists are also contributors.

I am not sure who began the 'magnetic' sense of attraction, but I am fairly sure that this marked a figurative expansion of the term at the first usage. The word's earliest English meaning is that which it takes from its Latin origins, 'to pull or drag towards,' that is, to draw towards oneself by such physical means as a rope. It soon gains other meanings as well, namely, the medical 'to absorb, draw' (as in 'to draw the poison'), the psychic 'to affect the will of animals and men' ('she has always attracted me'), and the magnetic or electrical 'to draw towards itself without visible means.' All these usages leave out, we may note, the 'visible means,' since none of these meanings denotes such an operation as pulling with some sort of tie. But what, then, can they denote?

This became a source of contention when Newton utilized the term, fresh from magnetic studies, and compounded the offense by adding a 'new' meaning of gravity with its help. Up to that time, gravity had been synonomous with weight, the heaviness of a thing. It now became, like Bottom, 'translated', to 'mutual attraction of solid bodies at a distance.' All this in a single jump. Some were made a bit dizzy by the event, and complained. Owen Barfield, writing in a philological study, remarks that the concept of 'action at a distance'

> must have been practically beyond the range of human intellection. There was formerly no half-way house in the imagination between actual dragging or pushing and forces eminating from a living being, such as love or hate, human or divine, or those 'influences' of the stars which have already been mentioned.[6]

But the sense of invisible 'forces' caught on quickly enough after Newton published his Principia. Or at least, it caught on in the popular sphere. The new meaning of both <u>attraction</u> and <u>gravity</u> went into the common language and stayed there, but as Barfield remarks, they presented continuing difficulty to some men who continued to complain:

> Philosophers and scientists, however, have continued to boggle at this notion of action at a distance. Thus Leibnitz, shortly after Newton published his discovery: "Tis also a supernatural thing that bodies should <u>attract</u> one another at a distance without any intermediate means." And Huxley in 1886, on the terms <u>atom</u> and <u>force</u>: "As real entities, having an objective existence, an indivisible particle which nevertheless occupies space is surely inconceivable; And with respect to the operation of that atom, where it is not, by the aid of a 'force' resident in nothingness, I am as little able to imagine it as I fancy anyone else is." Hence the invention of the hypothetical <u>ether</u>, in order that space might be supposed filled with a continuum of infinitely attenuated matter.[7]

This is a very notable case of expanded meaning. We know when it was done, and, at least in the case of <u>gravity</u>, by whom. But there are many such cases in the history of the relation of language to science; one need only scout them up. (It will be useful, for anyone who desires to undertake such work, to familiarize himself with the etymologies of common scientific terms first, in order to sensitize the mind to shifts in meaning. Too often we read our modern meanings into the older texts, and never notice the change actually taking place.)

The non-figurative, 'ordinary,' or 'customary' usage of a term is generally called the 'literal usage,' and I shall adopt that terminology here. Since the literal usage of the word <u>attraction</u> denoted, when Newton was born, attraction by mechanical means, the use of the term to describe the activity of magnets must have had a figurative cast for the audience of his generation. The listener, hearing magnetic phenomena described with the term, was obliged to 'look through' the literal meaning to find another, the meaning of the speaker before him. The literal meaning of the term would still be immediate for the mind, but since no direct application of that meaning could be made to the observed appearances, the listener is forced to take the immediate denotation as a figure (symbol) for the desired denotation. <u>Attraction</u>, when applied to magnetic phenomena, called up an immediate sense of 'pulling towards itself by mechanical means' to describe a situation in which no such means could be found. The audience abstracted 'pulling towards itself' from the means, and attempted to 'see' the situation in these terms. Here the <u>results</u> of mechanical attraction are present without the means, and the 'feel' of the figure becomes a sense of an invisible tie of 'force' between objects which tends to bring them together.

When this notion is applied to weight, or at that time, gravity, we get our modern sense of things being 'pulled' towards the ground beneath our feet by the same invisible tie which holds the orbiting moon (or space vehicle) from flying away from the earth. We take this for granted, but let us look seriously at the manner in which the situation must have been represented before Newton's contribution. The weight of anything, the force with which it was driven towards the earth, was, in the middle ages, something more like unconscious will in the thing itself, which was pushing (rather than being pulled) towards its proper place, the center of the celestial sphere (and thus its lowest point) which was also the center of the earth. This, the historian of ideas will quickly tell us, is the old Aristotelian 'proper place' theory of gravitation. But calling it a theory obscures the distinction between perception and hypothetical interpretation.

If the notion of attraction was really absent, then the energy exerted on the palm of the hand by an object resting there would have seemed like an impulse originating within the thing itself. We would not need to consider 'action at a distance' because the action was performed <u>by</u> the object, without any involvement on the part of the body of the earth. This attitude was not essentially modified until Newton made the change, and thus, however watered down (the sixteenth century lost the notion of 'proper place'), we must see the 'place' theory, or better, mode of representation, behind the manner in which gravity was experienced by Newton's contemporaries.

What sort of difference did Newton's work bring about? Obviously, the change is more than a hypothetical one. A gravity of impulse 'feels' different from that of attraction. In the former, we feel the energy to be exerted in isolation, in the latter, through relation with the earth. The physical details remain exactly the same, but the actual experience of these seems to change. What has actually altered, of course, is our mode of representation, but this is more than a hypothesis.

Turning back to a purely linguistic consideration of the process by which Newton introduced this change in manner of representation, we may begin to see why figurative usage plays such a key part in scientific progress. The scientist must have the freedom to change his manner of representation for a better, if he believes he has found one. But even as a manner of representation is symbolic, in that it looks through the physical details to something 'felt' to be expressed by them, so figurative language 'looks through' the first level of immediate or literal denotation to a second which is the present speaker's meaning. But that secondary denotation is a denotation none the less.

Gravity, in Newton's sense, is now a literal meaning. Yet, as we have just seen, it was once figurative. The evolution of this modern sense of the word from a figurative to a literal status was not dependent upon any addition of meaning which might make for greater clarity or directness, but by a loss, over time, of the earlier meaning. As a figure, the term gravity had a two-leveled 'feel,' a literal meaning which was transparent to a second denotation. These two levels correspond to the figure and the figured, the symbol and the symbolized, respectively. The figure was the earlier literal sense, the figured the present sense. When the memory of the earlier sense was lost from popular usage, only the figured sense was left, and thus what was once the ultimate but not immediate denotation of a figurative usage becomes its only denotation.

The evolution above happens more often than is generally realized. An enormous number of modern literal meanings were once figurative speaker's meanings, but have since lost their original denotation. We no longer 'feel' anything figurative in the usage for we are no longer aware of the earlier meaning, even when we see it used in an early text, since we usually read in our present meaning. How many now hear, for instance, the Latin sense of penalty, fine, or punishment in the phrase 'on pain of death'? Yet this sense, now fully obsolete, is the earliest meaning of the English word pain, and the intended sense of the usage above. The word has shifted from the notion of external penalty—particularly legal penalty—to the internal reaction of such penalty. The term must have presented interesting opportunities to the lyric poets of sixteenth century England, which period saw the birth of its modern meaning, since they were very fond of figures which attached penalty to romantic love. When we are made aware of its earlier sense, particularly its legal usage, we can easily imagine the figurative 'feel' the term may have had for the sixteenth century audience in such a phrase as 'feeling the pain of your displeasure.' By the present date, the original meaning has completely given away to what may well have been a figured meaning in its inception.

Since the present literal meaning of a good many English words, including a number of scientific terms, was once the figurative speaker's usage of the same terms, it would seem that any argument to the effect that figurative language does not have a literal denotation is a non-starter. The only difference, in such cases, between the figurative and the literal use of the term is time (during which the older meanings pass out of the word). The earlier figurative meaning *is* the later literal one, in language in general as well as scientific language.

There is not, then, any linguistic ground for objection to figurative usage. It simply will not do to say that a usage is 'merely figurative,' since there is nothing pejorative in the fact of figurative usage. It is not the structure of the language that causes difficulty here, but rather the ability of its users. Figurative speech takes greater effort and skill, both to make and to understand, than literal. If the speaker lacks the requisite powers, or understanding of the uses of language, his figures will lack meaning. It is indeed more difficult to be 'accurate' in figures than it is to be so in literal usage, and correspondingly, it is easier to be sloppy in figures, since the license may be all too visible if we stick to customary meanings. Yet for the poet, and/or the scientist, the demand that language be made to communicate new modes of representation (at least, new to the language), makes customary usage far too narrow.

The real question concerning figurative usage is the denotation, the figured. If the intention is empiric description, then a good figure is one that has a figured (denoted) content of empiric experience. Whether the figure does or does not have such a denotation cannot be investigated by examining language alone, but only by turning to the phenomena intended. In this way, the question of language becomes one of perception.

I have been referring to the aspect of perception crucial to this discussion after the Kantian terminology as a 'mode of representation,' or sometimes, in order to facilitate intuitive recognition, the 'way of looking.' Up to this point I have taken Kant's concept for granted, but now I must modify it since I mean to indicate something more general than his notion, and hopefully, more obvious.

(b) Perception: the representation and the represented

The reader will remember that Huxley once compared Goethe's work to that of Casper Friedrich Wolff, giving the impression that, had Goethe known Wolff's work, he could have avoided all that idealistic speculation and realized the true import of his own observations. Well, Goethe did know Wolff's work, at least from 1792 onward, since in 1816 he wrote that he had been studying his writings for more than twenty-five years. But his judgment, at the end of this period, is not at all similar to that which Huxley might lead us to expect. While he praises Wolff, both for his character and for the strength of his methods, he makes a pointed reservation:

> Because the theory of preformation and insertion, which he [Wolff] resists, is based upon an extra-sensible presumption, that is, upon an assumption which seems speculatively plausible but which may never be sensibly demonstrated, he sets as the fundamental maxim of all his researches: that one

> may assume, grant, and assert nothing other than what he has seen with his own eyes and is able at all times to reproduce. He is, therefore, always striving to penetrate the origins of the life-process through microscopic investigations, and thence to follow the embryonic organisms from their first appearance to their maturity. However excellent this method may be, through which he has accomplished so much, the worthy man never realized that there is a difference between seeing and seeing; that the spiritual eye [Geistesaugen] must work in constant and living union with the eye of the body, for otherwise one stands in danger of seeing the thing while yet seeing past it.[8]

The direct implication of the passage above is that the object of vision may be 'seen' in more than one way, and both ways are yet empiric experience rather than mere speculation, which Goethe rejects as firmly as did Wolff. If this is true, then there may be as many 'facts' in a particular percept as there are ways of looking at it.

The problem at issue is, of course, how to view the homologous series. Is its 'movement' empiric fact even if not physical fact? It is possible to look at the forms of such a series while they are in a random order and see only individual shapes built along similar lines. Certain basic structures could be pointed out. But nothing here goes beyond the physical situation. When we begin talking of the 'movement' of static objects, however, we have left the physical facts behind us, for no material continuity stretches between the individual forms. This 'movement' is an <u>appearance</u> only; we know enough, even as we view it, to avoid looking to confirm it through any sort of physical test. Yet there is little doubt that we <u>can</u> view a homologous series as continuous transformation; this achievement is well within our powers.

Ever since Kant pronounced that the innocent eye was blind, perception theory has been aware that sense perception, at least when it is intelligible (recognition), is not a completely passive thing. The mind's activity during perception, its selective attention and emphasis, pulling figure from ground, separating objects, forms, estimating and approximating, never allows the eye to simply register the stimuli it receives but, by adding the eye of the mind to the eye of the body, makes all seeing a 'seeing as' or 'taking for.' This intentional contribution to the sense percept (by which term I mean the sensible component of any particular perception) cannot be gotten out of empiric experience without destroying that very experience (by destroying its intelligibility). It is an activity that takes place in the very act of perceiving, its results already present to immediate reflection. All categorical, discoursive judgments come later. _They_ indeed can be additions _to_ experience, but the intentional component of perception is _part_ of experience. Given the present sophistication about this point, the empiricist has little choice but to recognize that empiric experience includes, by its very nature, an intentional component.[9]

I do not think that these statements will be strongly contended. The problem at hand is not the fact of intentional content, but the _type_ of intentional content which shall be acceptable to empirical investigation. It is a cultural commonplace that we 'see,' as Kant suggested, the notions of mechanics in the phenomenal evidence itself. Inertia, for instance, seems to be directly intuited when we watch the collision of two bodies, as 'attraction' is between the two magnets we hold in our hands. We already look at things 'in this connection,' i.e., related according to the intentional structures of the manner of representation we use to approach mechanical events. But here we supply only the connections between the sensible objects. When we come to the 'movement' of homology, the situation is somewhat altered and the intentional contribution somewhat larger. We must here represent, through the individual forms, a continuous transformation that is not sensibly 'filled in;' the proportionate contributions of the senses and the mind have shifted, it would seem, in favor of the latter. At this point some make objection.

Yet, any attempt to dismiss such content (as the intentional 'movement' above) as a subjective or perhaps 'occult' quality is obviously based upon an ontological presupposition rather than a direct examination of the phenomenal evidence. Of course, if one desires to keep all investigations within a certain framework, to reduce everything, for instance, to mechanics, then on that basis the elimination of homologous 'movement' from empiric descriptions would be justified. This is not to say, however, that such 'movement' is in any way subjective, but only that it is not a desirable evidence for the project at hand. Only the presupposition that the investigation at hand is the only valid investigation of phenomenal appearances possible (because, perhaps, we have already decided that reality is mechanical only) could deny the empiric validity of an appearance which did not fit it. If we are not yet ready to make a like assumption, then it would seem that the only valid criterion for empiric evidence is whether that evidence must be gained by an aisthesis, an intelligible perception.

Aisthesis, in this sense, may be qualified by two crucial aspects: it must be perceivable and it must be intelligible (recognizable) to immediate reflection. We may call it a representation, by the active subject, of the intentional structures of perception, through the medium of the sensible. It is then dependent, not only upon the skill and volition of the subject (a volition that is usually quite unconscious and habitual), but upon the nature of the percept as well. Thus while a hypothesis may freely, according to the whim of the investigator, depart from the phenomenal evidence to speculate upon what has not as yet been seen, an aisthesis, being itself a seeing (or hearing, or touching, etc.), cannot depart from the actual percept. No subjective arbitrariness of that sort is possible, for the subject may not will to see just anything in the percept (may not, that is, successfully), but must accept the determinations of the percept as well. Only those intentional structures which are in some sense approximated or supportable by the percept are possible aistheses. The represented structures are intentional, but they are found in the phenomena.

At this point, we may see that the fact that there are multiple possibilities for representation in the same sensible contribution is a fact <u>about that percept</u>. This may be better argued from an example. The reader will be familiar, I think, with the sort of picture that, upon inspections, turns out to be more than one picture. We find an example of one such pattern on Plate XVI. If we simply look <u>at</u> the surface of this page, we find it covered with 'ink-blots' of various shapes and sizes, but if we look <u>through</u> that patterned surface, we see, not simply a pattern, but an image. (Of course, most viewers probably see the image first, but it is possible to see the pattern.) We already have, therefore, a large intentional component, for we are forming an image of a percept that must approach, in its extreme simplicity, the bare minimum of sensible 'filling in' needed to see such an image. But while upon first viewing the page may seem to contain only one image, close inspection will show up another. We have, alternately, the image of a young woman, from shoulders to hat, in rather elegant dress, or an old woman, from chin to kerchief, in what seems to be more modest attire. They must, therefore, be 'made'out of the same 'ink-blots;' the young woman's ear becomes the old woman's eye, the young woman's neck-band the old one's mouth, and so on.

Because they share the same elements, the two images are mutually exclusive. One may see the one, or the other, or part of the one and part of the other, but never both complete images at the same moment. A single visual element simply cannot be both ear and eye at once; we may alternate between the two at a very rapid rate, but we cannot manage to <u>see</u> both simultaneously. Ear and eye are two quite different structures. When we organize the pair of dark areas (ink-blots) that we utilize for seeing the eye and the ear, we must structure them one way for the ear, another for the eye, and naturally, while we are representing the first structure through these areas we do not find the second there.

The alternation may be controlled, to some degree, by the effort of the viewer. It is not accompanied by any change in the sensible contribution. There are, evidently, distinctions to be found within the sphere of appearances that do not exist for the senses. Should we discount them because of this? But how can we? The pattern on Plate XVI can no more justly be reduced to 'a number of variously shaped dark areas on an otherwise white surface' than a Rembrandt reduced to 'variously shaped colored areas which entirely cover the surface of the canvas.' At the least, we should like to know <u>what sort of shapes</u> are being spoken of. Well, what sort are they? To do justice to this question, we should have to describe the image on Rembrandt's canvas, and likewise, that on Plate XVI. But there are two images on the Plate, and since we have no reason to assign precedence to one or the other (unless we have never seen a second), we must mention <u>both</u> for the same reason that we must report the one painted by Rembrandt—we can see them.

It would seem, therefore, that a number of different structures may be represented, successively, through the same percept, simply by changing the manner of representation, and that all are equally seen and, for that reason, all are empiric evidence. Of course, all these representations will not be equally useful to the individual investigator, who has a specific question in mind. For his purposes, it is very likely that only one of the possibilities of representation will be important. But to utilize a particular mode of representation and then attempt to explain the results on the basis of a conceptual scheme abstracted from a very different mode of representation is to confuse councel. Yet this is exactly what we see done by some of Goethe's critics.

Both Huxley and von Jaeger seem bound to reduce the apparent 'movement' of a homologous series to actual movement or transformation of a material sort. (And of course, Darwin built his whole edifice upon this impulse.) Since Huxley's explanation has already been criticized to some extent, let us examine von Jaeger's. His remarks, as interpreted by Agnes Arber, run as follows:

> we do not, as a rule, witness an actual process of transformation; to say that any organ, as we know it, has been 'transformed,' is thus merely a figure of speech. The term metamorphosis can only denote a change which we imagine happens in the formative forces (Bildungskräfte), rather than anything detectable in the visible members, though it is from the observed differences of those members that we deduce the existence of this underlying metamorphosis.[10]

Arber continues to add her opinion that "Jaeger's criticism is fully justified," but I do not think that it will bear close scrutiny.

The linguistic portion of von Jaeger's remarks has already been discussed above. We must now concern ourselves with the claim that metamorphosis, when applied to plant organs after Goethe's usage, must denote something happening in the unrepresented— the 'formative forces' which are evidently those energies which move material about within the plant body and deposit the same here and there as part of that body; these are imperceptible, but usually assumed to exist, since growth is a material change. If this is so, then Goethe is putting forward a speculative hypothesis. But can this donotation be the one he desires?

In order to take von Jaeger's claim seriously, we must ask how it is that a metamorphosis, which is not detectable in the visible phenomena, comes to be proposed (hypothetically) at all. Von Jaeger suggests that we deduce the idea from the nature of the observed differences between the organs. It is, of course, plausible that if two plant appendages are different, their growth processes will also differ and likewise the components of those processes. But why is this alteration termed a metamorphosis? This is a very particular sort of difference— a transformation, a change which is not a mere substitution but has an underlying continuity between the situations before and after. The identity of the transformed entity is in some sense preserved, even though that entity is altered. How did we arrive at just this type of alteration from the evidence of the visible plant members?

How indeed if not by the discovery of a structure, within the phenomenal evidence, which supports such a view. But the visible evidence is, in this case, homologous series, which, as we are well aware, is difficult to view without seeing an apparent 'movement' of transformation. If this apparent metamorphosis is to be cited as the phenomenal evidence upon which we postulate a 'real' but unapparent one, we shall have some difficulty in understanding (1) how it is that an apparent metamorphosis, obviously quite detectable in the visual phenomena since it is an aspect of the visual <u>appearances</u>, can serve as evidence for another metamorphosis which, by definition, <u>does not appear</u> in the visual phenomena, and (2) why the term <u>metamorphosis</u> cannot refer to the immediately apparent metamorphosis, but must have some other referent.

It is likely that these difficulties stem from the assumptions, on von Jaeger's part, that appearances deceive and that statements of empiric description can only refer to 'material <u>reality</u>,' which is evidently equated with that structure of appearances we discover when we investigate the world with mechanical ends in mind (when we are concerned with any of those operations which would be governed by the laws of mechanics). But this assignment of a material referent to all descriptive language is surely an undesirable one. It leads the investigator to pass, by an abrupt and somewhat arbitrary process, from his immediate representations to hypotheses about the unrepresented. Nor has he any choice in the matter, since he must, in order to force all his descriptions to refer to concepts which have been abstracted from the 'mechanical' mode of representation, place their referent within the unrepresented substrate of the phenomena. That is: since the investigator has decided, before-hand, that all appearances will be <u>interpreted</u> (not represented) with those concepts which belong to mechanics, when he comes to an <u>aisthesis</u> which represents, to him, structures which cannot fit these concepts, he goes <u>behind</u> the appearances, hypothetically, to speculate upon <u>unrepresented</u> 'causes' that will fit.

This habit of passing quickly into a speculative hypothesis about the unrepresented when faced with strcutures of appearance which can neither be ignored (the 'movement' of homology is the key to its detection) nor comprehended according to habitual concepts (that appearance of transformation is not accompanied by any physical transformation), is what leads to 'seeing and yet seeing past' the phenomena. It substitutes, prematurely, a theory <u>for</u> the phenomenal appearances. Thus von Jaeger becomes convinced that there is no way of verifying Goethe's statements about plant form short of making the imperceptible plant energies perceptible in some kind of test, and until such a test is possible, he must insist that Goethe merely speculates. In this fashion he sees the evidence, and yet misses the whole point.

Before one can do anything with the phenomenal evidence, it must be known, and this means the structures of appearance represented must be clarified. Such structures, being intentional content, may for that very reason be clarified conceptually, but only through those concepts which are developed in response to the represented structure, and not merely imported from another realm of experience. Before making any hypothesis about the appearance of metamorphosis in organic forms, therefore, we must ask what constitutes this appearance: what is the represented structure?

(c) The mathematical description of homology

The last chapter of D'Arcy Thompson's On Growth and Form consists in a demonstration that homologous forms, when projected into two dimensions, can be graphed as isomorphs of a continuous transformation. The entirety of Thompson's argument is too long to review here, but a small selection of his pictorial examples will serve our purpose admirably. He demonstrates that one may, by a rather simple operation, generate a deformation of a given figure by coordinate methods: the (X,Y) graph of Fig. 1, Plate XVII, for example, may be turned into the (X^1, Y^1) system simply by shortening the horizontal scale (X axis) while maintaining the vertical unchanged. The circle inscribed in the first system becomes, in the second, an elipse. But any form, once inscribed in a coordinate system, can be so deformed, as we see in Fig. 2, where the outline of the cannon-bone of an ox in system (A) is transformed, by substituting $X = 2X/3$, into the representation of the cannon-bone of a sheep in system (B). A further reduction, corresponding to $X'' = X/3$, produces the outline of the cannon-bone of a giraffe in system (C). Such transformations are extremely simple, but more complex ones may be reached by more complex variations.

Fig. 1 of Plate XVIII presents a series of drawings, after Dürer, which were intended to be instructive for the student of portraiture. The first three vary the face essentially by varying the (Y) coordinates, this time unequally. Numbers 4 and 5 transform the inscribed figure simply by changing the 'lean' of the (Y) axis. It was these latter drawings which gave Peter Camper his notion of 'facial angle' which he utilized in making drawings comparative of skulls of different species. Camper did his drawings without the axes, but his method is quite similar to this. As the reader must now be aware, if we can find a sufficiently complex manner of transforming our coordinate system, we could represent any homologous series (in two dimensional projection).

Take Fig. 2 of Plate XVIII for example. Portrayed are the Carapaces of various species of crab. Beginning with that of (1), we may see (roughly) the graphic transformations needed to derive the others from this beginning point. A transformation similar to that used in (4) provides the very striking metamorphosis of the small Diodon to an Ocean Sunfish, Orthagoriscus, in Fig. 3.

Here we have homology represented in graphic terms. The sensitivity of the method is very great (although certainly no greater than the eye of a trained morphologist) and with care, such complex organs as vertebrate skulls may also be treated in the same manner. Plate XIX demonstrates an application of graphic transformation to phylogenetic problems. Beginning with the inscribed skull of a Hyacotherium, an ancestral form found in the Eocene, Thompson moves to a map of a modern horse skull (H) which shares the same coordinates.[14] Stages (B) through (G) are then mathematically interpolated. Next, the skulls of extinct forms which are thought to constitute the ancestral lines of the horse between Hyacotherium and the present Equus are placed next to the series formed by interpolation and compared. All the extinct forms bear resemblances to the hypothetical ones, but (Pa) shows only a rather distant one. Thompson suggests, on the strength of this, that perhaps Protohippus (Pa) is a departure from the direct lines of descent and not an ancestor of Equus. (Of course, this departure of (Pa) from the 'movement' of the other forms was detectable by eye, but when it is displayed in this manner the size of the departure becomes impressive.)

Interpolations such as those of Plate XIX would have been possible in the case of the crab shells as well, had we desired to graph hypothetical intermediates. The important point is not that the two distant ends of a transformation can be mathematically represented as transforms (like the Diodon and the Sunfish), but that the transformation being shown is a continuous differential, or in other words, what we have been calling a 'movement.' If the forms may be described in this way, then they can be made to 'move' into one another, and the nature of this 'movement' has become somewhat clearer.

Attempting to describe the sort of deformation such a method of graphic transformation shows us, Thompson remembers seeing the "marbled papers" which one used to find on the inside covers of good books (and the fly):

> The "marbled papers" of the bookbinder are a beautiful illustration of visible "stream-lines." On a dishful of a sort of semi-liquid gum the workman dusts a few simple lines or patches of coloring matter; and then, by passing a comb through the liquid, he draws the color-bands into the streaks, waves, and spirals which constitute the marbled pattern, and which he then transfers to sheets of paper laid down upon the gum...though the method of application of the forces is simple, yet in the aggregate the system of forces set up by the many teeth of the comb is exceedingly complex, and its complexity is revealed in the complicated "diagram of forces" which constitutes the pattern.[11]

The example is near-perfect, for we may well imagine, were we able to control the gum's movement exactly, that the <u>Hyacotherium</u> and its graph (Plate XIX) could have been laid down upon gum, and the rest of the interpolated series produced by physical distortion of the same.

Thompson's point, in his treatment of homologous forms, was that such forms do not very atomistically (a comb here, a curved beak there), but rather as a whole. The deformation is continuous; it governs the whole rather than simply one part or another, and thus the morphological examination of organisms must recognize that they cannot be treated piecemeal. This can be seen in a particularly strong way if we remember the example of the flowing gum. The transformations shown here would all be producable by the proper flow-distortions of a semi-liquid medium (given that the graphs were laid out on this medium). Thus it is not a series of small but separate changes we are looking at, but a continuous distortion of the very 'space' within which the figure is inscribed. Of course, these are but two-dimensional projections, vastly simplifying the three-dimensional reality, but not, I think, falsifying it for that reason. The inscribed form changes in such a manner as to register a continuous deformation or 'flow' of the surface on which it lies, or the 'space' within which it exists. And it is this 'flow' of the 'space' which is our 'movement.'

Since this metaphor of 'flow' is likely to be objectionable to some, it may be helpful to point out that the mathematical procedures referred to here are used, in fluid flow studies, to map the deformation of any given zone or figure (imaginary or constituted by the border of one fluid with another) within a known flow of liquid (inside a water pipe, for example). The simplest way of performing this seems to be the assignment of differing velocity vectors to each point plotted. Once the differentials have been entered, with the plot, let us say, at time (T), the figure may then be plotted for any subsequent time (T + X). Thus at least mathematically the relation between two-dimensional projections of homologous forms in serial order is parallel to that between stages of a transforming zone within a flowing liquid.

Thompson was so impressed with this similarity that he ventured to assume that organisms progressed through their phylogenetic evolution while under repeated physical stress (always of a similar nature), which was somehow produced by environmental conditions, and which acted upon their bone structure in such a way as fluidly to deform it. The stress was repeated with every generation, and the deformations of previous generations inherited. This neo-Lamarkian hypothesis has since been abandoned. (It was a notable instance of passing too abruptly to a hypothetical unrepresented, this time because the represented structure of the phenomenal appearances was the same, when plotted as a surface deformation, as that found in certain physical situations, and thus the investigator makes a hypothesis about similar situations lying behind the visible appearances.) The notion of differential flow has been retained and adopted to the study of growth differentials (also mapped the same way). Thompson had, therefore, a crucial idea in his hands, but he was unable to see it clearly for his speculations on physical forces.

(d) Some conclusions

The ability to plot or map a continuous deformations does not itself, constitute an understanding of the same. Such mathematical treatments simply allow us to reproduce, at will, any selected stage of the process, or, if one has access to the proper computer, see the whole transformation as a continuous movement on the oscilloscope screen. In this manner we may reassure ourselves that there is a direct structural parallel between homologous forms and arrested stages of flow transformations. We must still, however, come to a concept of such transformations, and this concept is not the mathematical description.

We are able to _see_, with the aid of the proper mode of representation, the 'movement' or 'flow' of a homologous series, and to _see_ is, in this context, to _represent_. If the image seen is the _representation_, that which is _represented_ by it will be the intentional structure discovered within it. This structure is, in the case in point, 'movement,' and quite particular 'movement' at that. When we watch human gestures, we rapidly discover that a certain conventionality rules this sphere. There are _types_ of gestures, and usually one sort is not confused with another. The same distinction may be made between the 'gestures' of several differing series of homologous forms: each has its own recognizable 'movement.' In order to adopt a consistent terminology, let us call the form of any particular movement, whether physical or metaphoric, its _gesture_ (that is, the _gesture_ is the element which several different physical movements could share, but which would allow one to distinguish one _type_ of movement from another). The near correspondence to colloquial usage supports an intuitive grasp of what is meant—we all understand, for instance, that when we speak of the _gesture_ a person made at a point in conversation, we do not mean the individual movement of his arm (which is unique in time), but the type of movement it was.

Let us look, now, at the 'rule' by which a homologous series is constructed. Given the forms of the series in random order, we select any two and place them in juxtaposition.

They are different, and this difference is made focal by the comparison. We then view this difference as the appearance of movement or transformation, and begin to fit in other forms. We place a form either between the two forms already on the table, or to the left or the right of the row that they make. One of these positions is satisfactory, and we proceed to try a similar addition with another form (assuming, of course, that all the forms we have will fit in the same series). We reject a suggestion of position, or find it satisfactory, according to a rule which is emerging right out of the phenomenal evidence, namely, the apparent 'movement' or <u>gesture</u>. We do not bring the particular <u>gesture</u> with us, but rather develop it from our representations themselves. Yet it functions as the rule by which we order the growing series and, for that reason, possesses the barest essential qualifications of a <u>type</u> concept.

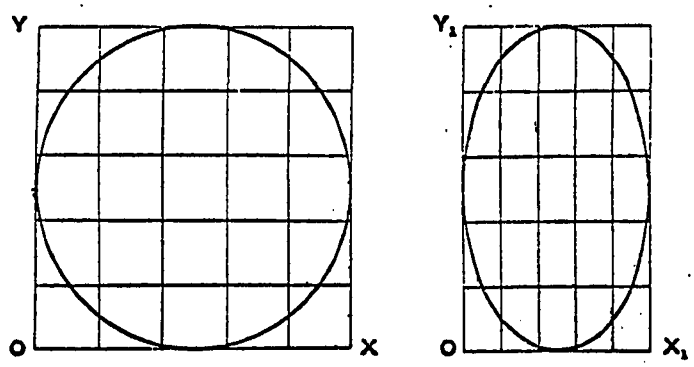
The crab carapaces on Plate XVIII, for example, would probably all seem typical, when grouped together, without being plotted as they are in Fig. 2. But once they have been so plotted, the impression that they are obviously all examples of 'the same thing,' or typical examples, is overwhelming. (This evidence so impressed Goldschmidt in his <u>The Material Basis of Evolution</u>, that he argued, on its basis that genetic theory must accustom itself to recognizing that the organism must be treated, not as a collection of independently varying parts, but as a whole. Thus the separate genes, which in themselves can be independently altered, cannot cause atomistic changes, but the contribution of each must run throughout the whole.[12]) It seems clear that the 'same thing' of which each of these shells is an example is the intentional structure which we emphasize in appearances when we pay attention to typical similarity (typische Ähnlichkeit in Adolf Naef's terminology— that resemblance which obtains between homologous forms). Each form exhibits the same structure, which structure is, in this case, its inclusion in the same gesture.

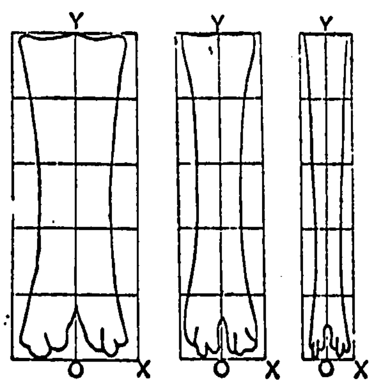
The end of this analysis is, therefore, that Goethe has evidently restricted himself to the description of the seeming gestures of the succession of plant form because it is this very element of gesture which lends typicality to appearances. We must remember, of course, that his original question was one of recognition:

> how could I recognize that this or that form was a plant if all were not built on the same model?[13]

His search was directed, therefore, towards that structure of appearances which facilitated this recognition. Instead of a static form, however, he suggests something entirely fluid, and for this reason is usually misread (his admirers and detractors alike search for static schemas in his text).

The idea is, after all, unconventional, and even now, having come this distance twoard it, we may yet find it very problematic. This is due to the fact, I think, that the relation of the represented content to the representation (phenomenon) is not clearly understood. Once this matter is settled, Goethe's approach will gain an epistemological justification.





A B C

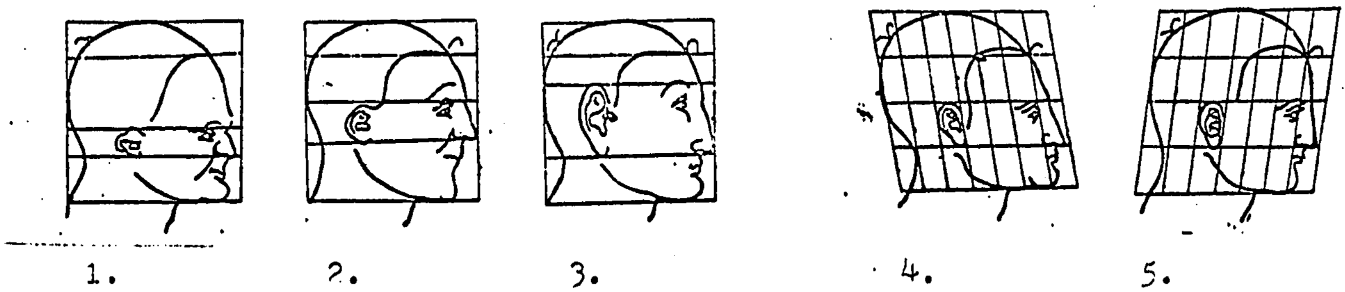
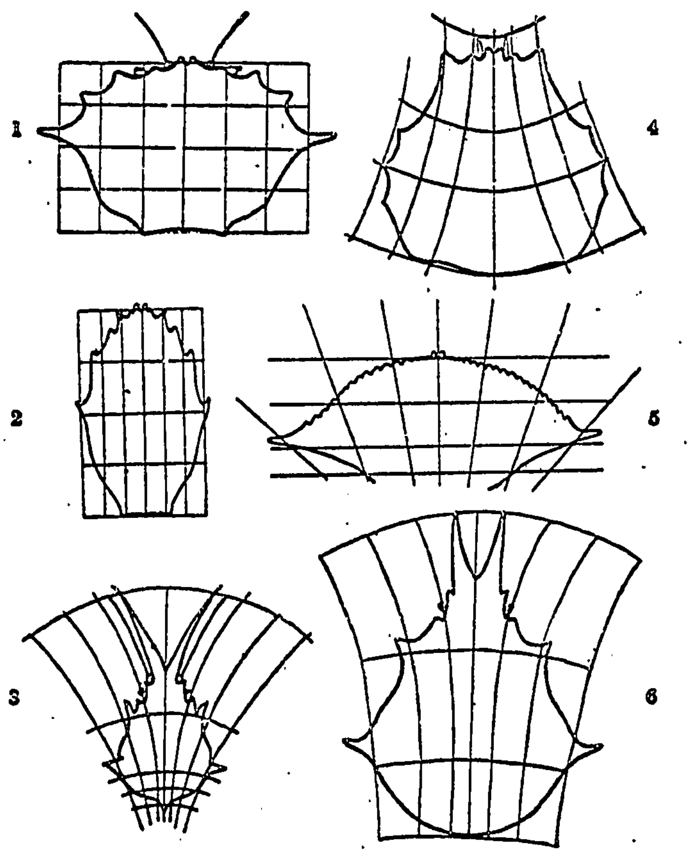


Fig. 1



Carapaces of various crabs. 1, *Geryon*; 2, *Corystes*; 3, *Scyramathia*; 4, *Paralomis*; 5, *Lupa*; 6, *Chorinus*.

Fig. 2

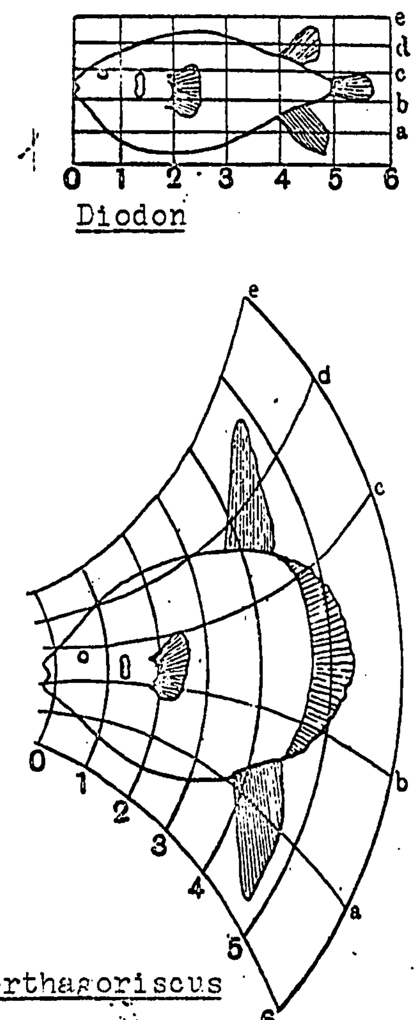


Fig. 3

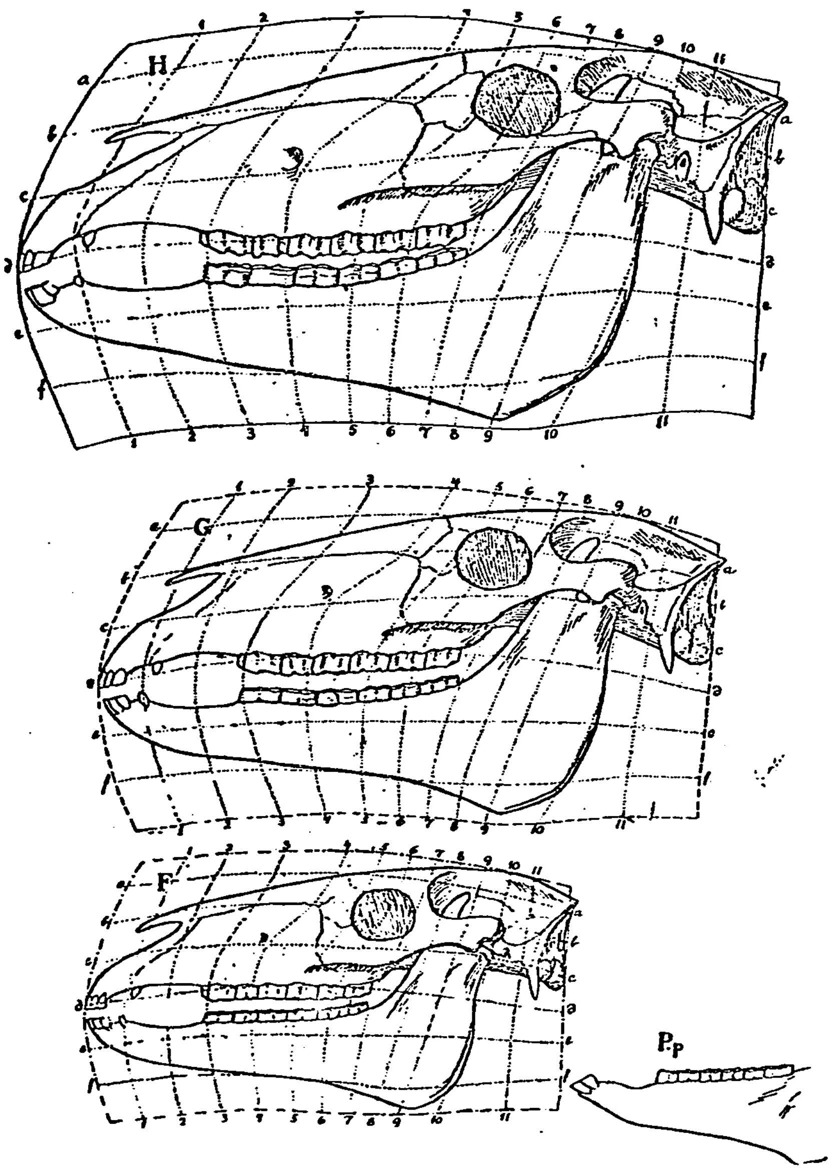
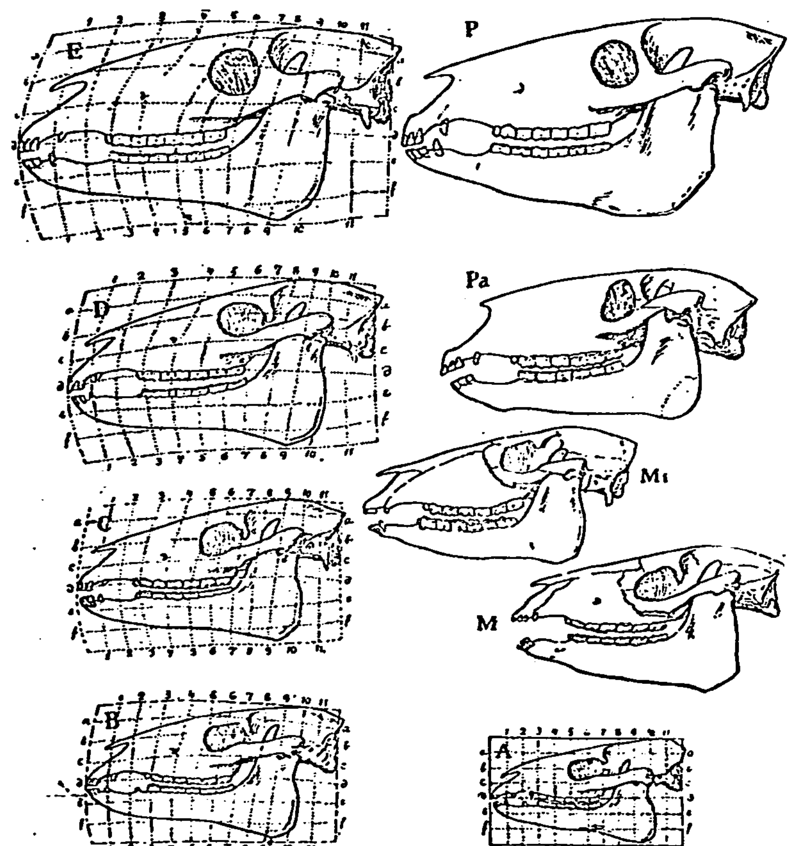


Fig. 546. A, skull of *Hyracotherium*, from the Eocene, after W. B. Scott; H, skull of horse, represented as a coordinate transformation of that of *Hyracotherium*,



and to the same scale of magnitude; B–G, various artificial or imaginary types, reconstructed as intermediate stages between A and H; M, skull of *Mesohippus*, from the Oligocene, after Scott, for comparison with C; P, skull of *Protohippus*, from the Miocene, after Cope, for comparison with E; Pp, lower jaw of *Protohippus placidus* (after Matthew and Gidley), for comparison with F; Mi, *Miohippus* (after Osborn), Pa, *Parahippus* (after Peterson), shewing resemblance, but less perfect agreement, with C and D.

IV The Dialectic of Experience

When Kant insisted that our representation of organisms was such that the resultant unity could not be mechanically explained, he admitted, by the same judgment, that we were able to recognize a structure of appearances which was not mechanically, or additively, constituted. This recognition had to be a positive one. That is, we could not postulate an organic unity upon the mere _lack_ of mechanical structure, for such a lack would indicate either that we had not yet found the structure involved (and thus it might be mechanical after all), or that the percept lacked structural unity altogether; in either case we fall short of another type of unity. Kant, of course, went so far as to designate what sort of structure organic appearances had, namely, one in which the whole appeared in the part. (Each part seems to be representative of the same life and identity.) From this appearance, one could reason that, were a determining principle for such a structure to be found, it would have to determine its own parts as well as be determined by them (since the part in this case must in some sense contain the whole, the part cannot be independent of that whole), and this was impossible on the basis of the concepts of Newtonian science.

It would seem therefore, that Kant, in order to conclude that organic structure was not derivable from the concepts of mechanics, had to demonstrate what sort of structure it was. The structure itself, therefore, was cognizable; what lay beyond human cognition was the causal factor. One could discover how things were arranged, but not why. But the task of science was causal explanation, and this task could never be completed with regard to organic life.

(a) Explanation or description

It was the demand for causal explanation which led to the great enthusiasm for Darwinian biology. Darwin had placed biology on historical grounds, showing how one phenomenon gave rise to the next; he was, in short, Kant's 'Newton of the grass blades,' whose efforts had changed biology from a merely descriptive to a causal science. Kant would not, of course, agree with this estimation, since Darwin was unable to explain organic form on a mechanical basis (having shown only how that form develops historically), but he would agree that a science of explanation represents an advance over mere description.

Explanation, for Kant, was causal, and therefore sequential. To explain was to show how one phenomenon produced the another, in a necessary order. This, according to Kant, was the nature of the Newtonian accomplishments. In the case of organic life, however, the structure of the living organism could not be so explained, since it originated from another like structure (the parent organism), and was never seen to arise out of inorganic pieces. Thus a _cause_ for that structure itself was nowhere phenomenal, and since the object of human knowledge is human experience, this cause, being beyond experience, was also beyond knowledge. This line of reasoning seems clear enough, but let us reflect a bit further on this notion of science.

Newton's discovery and formulation of the 'law of gravitation' was perhaps his most notable success. Was the accomplishment an _explanation_ in the Kantian sense—does it show us that a former phenomenon necessarily produces a subsequent one? The answer would seem to be yes, since we may understand how the operation of gravity will produce new phenomenal situations out of previous ones according to necessary laws. But is this to say that the earlier situation _produces_ the later? If we think of falling objects, how can the earlier event (removing the support from a body) be said to _produce_ the subsequent (the acceleration of that body towards the earth) when it is only by the intercession of _gravity_ that the first situation is led over into the second? Yet gravity is not itself phenomenal, except as the intuited connection between the first and subsequent phenomena. Only the mind ever 'sees' the operations of gravity; it is a connection between sensible percepts that is thought but not sensibly filled in (a Kantian concept, by his own analysis), and thus may be intuited only in the actual sequence of change (the acceleration of the falling body). If gravity is the productive power here, it cannot be identified any more with the first situation as with any single later one (any point in the acceleration), but only with the entire change, being the connection between states. And this conclusion will put causal 'explanation' in a new light.

Kant admitted that organic structure could be described, but distinguished this from an explanation, the latter being the goal of true science, as exemplified by Newtonian physics. To explain something was to show why it came about, relating the earlier and later situations by necessary law. The law of gravitation could explain, for instance, why an unsupported body accelerated towards the earth, showing that the acceleration must follow the removal of support. But all this looks a bit different through different eyes:

> in the solution of natural phenomena, all the length that human faculties can carry us, is only this, that, from particular phenomena, we may, by induction, trace out general phenomena, of which the particular are the necessary consequences. And when we have arrived at the most general phenomena we can reach, there we must stop. If it is asked, Why such a body gravitates towards the earth?

> all the answer that can be given is, Because all bodies gravitate towards the earth. This is resolving the particular phenomenon into a general one. If it should again be asked, Why do all bodies gravitate towards the earth? we can give no other solution of this phenomenon, but that all bodies whatsoever gravitate towards each other. This is resolving the general phenomenon into a more general one. If it should be asked, Why all bodies gravitate to one another? we cannot tell; but, if we could tell, it could only be by resolving this universal gravitation of bodies into some other phenomenon still more general, and of which the universal gravitation of bodies is a particular instance. The most general phenomena we can reach, are what we call laws of nature; so that the laws of nature are nothing else but the most general facts relating to the operations of nature, which include a great many particular facts under them.[1]

That statement, which catches Goethe's view of law very well, was made by the rather neglected Scotch philosopher Thomas Reid. It is well worth our consideration, for it presents Newtonian physics as a descriptive science, thus suggesting an aspect that Kant may have overlooked. Does it work?

As Kant himself might have argued, there is a certain sense in which gravity may be said to be phenomenal, namely as the intentional connection between successive states that makes the succession an intelligible phenomenon: a lawful effect. As soon as this is granted, the rest follows easily. The earlier situation and the subsequent ones are necessarily connected only if seen within the context of law, or if the transition from the first through the others is seen as the operation of gravity. This operation can be generalized (all bodies are coattractive), but it cannot itself be explained. (The speculations about 'ethereal fluid' which were aimed at explaining the activity of gravity represented just that sort of hypothesizing that Newton took to be inferior science.) We have only to describe the most general appearances of which our law is the necessary structure, and any particular event that falls under the law will appear as a necessary consequence of that general description. Here explanation and description merge, the explanation of a particular event consisting in the demonstration that this event is an instance of the general pattern.

If this analysis is correct, however, then Kant has made a serious error in his doctrine of causality. Noting that all representations are successive (ordered within time), Kant argued that our only means of distinguishing subjective sequences from objective ones was conformity to a rule, and the notion of this rule was the category of causality.[2] The rule for the sequential order of representations, therefore, becomes the primary goal of all science. But let us turn back to Reid.

According to the Scottish philosopher, we formulate the law of gravitation by the most general description of its operations. We seek for the lawful within appearances, in any science, and since in this particular case we are inquiring about falling objects, we seek for that law which appears through all such events. But notice that the event in question is a fall; the movement of a stone from the time it is released by the hand until the moment it strikes the earth. This is one phenomenon, not several. We might actually speak of several different percepts, since the stone continually changes its position with regard to the eye, but the mind synthesizes all differences into one continuity. The law of such events, therefore, must unite the entire sequence of positions; it is a law governing sequence due to the fact that the phenomenon it governs is a sequence, and for no other reason. To generalize the demand of causal sequence beyond this would, by definition, force one to speculate beyond the phenomenal appearances. This is just what happened when lesser scientists, and even Newton in his weaker moods, speculated about the cause of gravity itself. (Gravity was the law inherent in the phenomenal sequence. But gravity itself is not phenomenally preceeded by anything, and thus some men began to imagine an 'ether' or supply an imaginary prior cause.)

Reid's notion of science,therefore, is the search for the lawful structure of phenomenal appearances. Kant's might at first seem the same, but it is actually something quite different. For Kant, the real task of science is causal sequence, the necessary rule for the sequence of events. And if the phenomenon under examination does not include such a sequence, Kant will still insist that an explanation of that phenomenon could only be an account of its lawful position in some sequence external to the phenomenon, and this is how he generates his distinction, within biology, between description and explanation.

Faced with a common plan within some zoological type, the strict Kantian would have to see the ultimate question in the historical sequence which gave rise to that plan (which is why so many thought Darwin had solved the problem posed by Kant). But if the common plan is the law of the appearances within the type, then to demand to know the conditions prior to its advent would be quite parallel to asking the conditions prior to the advent (not operation) of gravity. But in asking such questions, we act as if the ultimate explanation of an object or event were some earlier object or event, and this is manifestly false, since these earlier and later entities are not related except by law, which is not itself an object or event.

(b) On law

I have used the term law to indicate a relation, found in appearances, which commands a rational necessity and is therefore not merely a summary of past experience. Gravity, for instance, is a descriptive law (at least according to Newton and Thomas Reid), a general fact of appearances, but it is also an idea. Having seen appearances in this manner, we must see in the weight of any body an expression of that same relation to the earth that is seen in its falling towards the earth, even though these events are perceptually distinct. We must find an implication of some causal element beyond this relation when we speak of any body rising from the earth's surface, since that movement could never be logically derived from it (i.e., from attraction). The separation of stone and earth is, indeed, a logical contradiction unless we introduce the notion of interference from another source, the relation between the stone and the earth (the former resting on the latter) containing no generative possibilities for that separation. No mere summation of past experience could provide this logical structure.

Law in this sense may not be equated with hypothesis, but only with fact, or phenomenal appearance, and is presented in the form of a generalized description. (I have reduced fact here to 'empiric experience,' which removes the ontological claims which might otherwise accompany it.) The law within the appearances of vertebrate skeletons, for example, is a continuity actually seen between the skeletal forms. Those forms may, of course, be observed without reference to this continuity, but they are not then seen to be typical. When their typicality is recognized, in a human hand, a bat wing, a cat paw, or a fish pectoral, it is revealed as a quality of the appearances as experienced, not an interpretive addition. The seen commonality between orange-red and blue red, that is, the redness of both, is not a matter of hypothesis but fact; an exemplarity apparent to immediate reflection. In a similar fashion, the typicality of vertebrate skeletons is discovered through the immediate recognition of structural exemplarity. We do not add it by a hypothesis constructed posterior to the experience of seeing, but find it in the percepts just as we find something imaged in the percepts of Plate XVI.

Coherent rational structure may be found within phenomena for the very reason that phenomena are recognizable (cognizable) at all— they have been grasped as representations of some intelligible quality or structure. Thus, in Reid's account, certain phenomenal appearances have been grasped as attractive, i.e., as the expression of 'gravitational attraction.' They were not merely interpreted this way, but seen as such. The relation between the individual phenomena and the law is one of exemplarity, but this exemplarity is found through an aisthesis rather than a hypothesis. In order to understand the notion of causality that arises from this view, however, we shall have to think of something reminiscent of an Aristotelian formal cause (Kant's idea of causality is definitely in opposition), the law found within appearances being the form by which those appearances are structured. A recognition of the idea given in appearances (rather than hypothetically applied to them) entails a good deal more than first meets the eye.

This may perhaps be clearer in the case of magnetism. When I bring two magnets together in various orientations, I can rapidly discover for myself the attraction-repulsion polarity that is the idea of magnetism. I experience the attraction or repulsion directly. But I experience this only if I do not restrict myself to a mere generalization on past events. Were I to find nothing more in my experience than the fact that every time I brought the magnets into proximity in one orientation they moved towards each other, and every time I brought them near in a different orientation they moved away from each other, then I have not as yet introduced any rational necessity and my investigation falls short of law. The moment

I intuit movements as attraction and repulsion, however, the phenomenal behavior of the magnets becomes an expression of lawful necessity, and I have an explanation of appearances. But now let us look closely at this 'explanation.'

If I am asked: Why does the left magnet move? I will answer: Because of the attraction between it and the right one. But why do they attract one another? Because all magnets attract one another. But why? At this point I shall remind the enquirer that these objects have the name 'magnet' in order to indicate, not that they are made of a particular substance (magnets may vary widely in composition), but that they exhibit just that behavior that we term 'magnetic,' which behavior includes attraction. To ask, therefore, why magnets attract each other is quite similar to ask why attraction attracts; the answer is analytic. The <u>cause</u> of this behavior is the peculiar property of magnets: magnetism. And magnetism is, in turn, only that behavior that is governed by the idea of attraction-repulsion that is indicated by the term.

I can, of course, speak of magnetic 'forces,' but I must be cautious with this practice. Unless by this I mean to indicate some aspect of appearances, something which is, like the idea, found within the appearances themselves, then the notion becomes a speculation about the <u>unrepresented</u>, and I have entered into a very different sort of investigation. I am now asking for the unrepresented cause of magnetism itself, which is exactly parallel to asking about an unrepresented cause for gravity. I can do this if I chose, but I must then be prudent enough to recognize that I am on speculative ground.

For Reid, and for Goethe, knowing the <u>idea</u> was enough. This made appearances immediately intelligible through their exemplarity, and when asked for the productive <u>cause</u> of gravitational or magnetic phenomena they could only point to the laws that governed such phenomena, or the <u>form</u> of appearances.

<u>(c) Definition and characterization</u>

As we have seen from the historical sketch in chapter II, Part II, it was not always very easy to 'point to the laws.' The communication of a notion of phenomenal intelligibility to a mind already in possession of a different notion is a difficult task, evidently more often unsuccessful than not. After all, one's entire vocabulary might have to be reinterpreted. A 'law,' in one man's understanding, was the actual structure of appearances, but for another it could only be a hypothesis. <u>Ideas</u>, for one, were <u>part of</u> the phenomenal evidence, but for another, subjective products of man's mind meant to <u>refer to</u> that evidence. The whole method of approach to empiric phenomena would sometimes alter between individuals, and not the least the method of report, or description.

One of the most obvious approaches to the problem of identification is a list of attributes which belong in common to one entity and no other, which collection of propositions forms a definition. This was the model for the Linnaean mode of description, which classified flowering plants according to leaf shape, number of petals, number of stamens, etc. The same model was in Huxley's mind when he proposed the reduction of the meaning of the term <u>homologous</u> (in the 1858 lecture) to the claim that a number of qualifications would hold for each of the forms said to be part of a common homology. This is the approach used in the dictionary description of a substance: Gold; the most precious metal, yellow, lustrous, non-corroding, high specific gravity, high malleability and ductility. It is an efficient and simple strategy, and a great deal of human accomplishment depends upon it. But it is by no means the only way to go about description, and an overdependence on definition will cut the mind off from many aspects of phenomena.

A striking example of just this may be found in the lectures of Helmholtz. In 1853 he talked about Goethe's <u>Metamorphosis of Plants</u> in Berlin, praising the piece as a work of genius but despairing, at the same time, of its usefulness to science. The problem, as Helmholtz explains to his audience, is that Goethe's genius is poetic, and expresses itself in figurative language. Naturally, this language must be made literal for the uses of science, and Helmholtz proceeds to substitute a definition for each key term. Goethe's type concept, or common plan, was designated simply as <u>leaf</u>. Since this term could not be equated, in this usage, with a foliage leaf, but is rather the organ underlying all the forms of the plant appendages (the 'same thing' which appears in all), Helmholtz substituted for this term 'lateral appendage of the plant axel.' He reasoned that since no matter what form this underlying organ had, it was always a lateral appendage, it could be defined accordingly, but

> If one attempts to express the proposition "the flowering parts are transformed leaves" in the form of a scientific definition, he converts it to the rather different "the flowering parts are lateral appendages of the plant axel," and to see this no Goethe was needed.[5]

Helmholtz was quick to admit that these rather depressing results stem from finding nothing more in Goethe's term than 'lateral appendage of the plant axel,' and that Goethe certainly would not have accepted that reduction, but his point was served by this admission. He argued that Goethe's idea was undefinable, and science may proceed only on the strength of definitions.

Of course, a familiarity with Kant would allow us to predict that Helmholtz, even if he had shown more invention, would come to grief in attempting to define a type concept. A definition compiles a list of attributes which coincide in the defined entity, but, hopefully, in no other. As a concept, therefore, a definition may only present an aggregate, a sum. The type concept is not additive however, nor does it identify by exclusion (by eliminating all entities that do not fit the list of attributes). It is an intuitive unity that determines the parts, and therefore the attributes, of the organisms of which it is the type. Indeed, it would seem that we could go in the opposite direction: if a notion can be defined, it will not serve as a type concept.

As early as 1840, William Whewell, an English biologist, had pointed out the distinction between the mode of comprehension behind a definition and a type. The natural class of objects, he wrote,

> is determined, not by a boundry line without, but by a central point within; not by what it strictly excludes, but by what it eminently includes; by an example, not by a precept; in short, instead of Definition, we have a Type for our director.[4]

But the suggestion was lost on the younger generation of morphologists, who were soon to turn from the problem of the type to historical considerations. No objections were raised when Huxley effectively dismissed the notion of type by reducing homology to a coincidence of attributes. If the methods of biology had not so altered since the death of Linnaeus, it would be possible to believe, on the basis of the mode of conceptualization, that the biological science of 1860 was still closely allied with the Linnaean approach.

Linnaeus was successful, after all, in much that he set out to do. His method, or something very near, is still the basis for botanical classification, and the approach of most guides for field identification of species. It is also the approach made by many parents in instructing the children on the recognition of poison ivy; a list of key attributes, three leaves, saw toothed, shiny, sometimes red, is memorized against future encounters. As I remember that effort on my part, it comes to mind that the list did indeed facilitate identification, but only after the fact. While lying in the middle of a nice patch of wide green leaves, for example, one would pick a stalk, examine it, and begin to recite, "Now let's see; three leaves on a stalk, saw toothed, shiny..." but by that time you were a little late. Things changed abruptly when my eyes gained that sophistication required to recognize at a glance, even 'out of the corner of my eye,' and I had a great deal less poison ivy infections in the summers. I no longer needed to apply the rule, the list of attributes, however, for I could recognize the plant as I would recognize a friend's face, and I needed no memorized 'three-leaf rule' for this sort of operation. But that is the exact weakness of the Linnaean approach. It does allow us to make definite identifications of species in the field (after much difficulty in _finding_ what we want), but once we can study the living plant, and grow familiar with it, we no longer use the field guide definition. Such a list is useful _until_ we experience the actual thing. Then, if we are willing to perform the required study, we can equip ourselves with a much more efficient method.

Identification by a list of attributes is actually the most abstract procedure, if by _abstract_ we mean 'removed from an actual _aisthesis_ by which recognition could take place,' by which to make an identification. Definition, as such, is simply a test which _excludes_ any undesired object, leaving only the target entity. It does not give us the insight into the target entity we should need to synthesize the list of attributes into characteristic appearance. The list given above for gold, for example, provides us with discoverable attributes but not with the intuitive link which brings them all together in a necessary way. The concept of gold gained by familiarity with the substance can provide such a unity, thus making the list a necessary one rather than merely a generalization on past experience. The list itself is innocent of any intuition of individual substance, however, and therefore of any necessity.

It was just this link between sensations, itself imperceptible to the senses, that Descartes attempted to demonstrate in his second Meditation, by pursuing what is constant among the many sensible changes that a particular substance (wax) may undergo. His treatment there, a juxtaposition or alteration of attributes (with a change of condition) and constancy of identity (in immediate recognition), evolves toward the conclusion that the recognition of wax by the mind takes place on the basis of some element perceptible only to the mind. The same argument might be made, at greater length, about any substance. (In this connection, the work of Edmund Husserl is most interesting.) Yet it is just this concrete unity of an individual substance which, being something which is not merely the list of attributes, but that which binds them together, cannot be defined. Definition being, it would seem, dependent upon just those properties which cannot be, in Descartes' conclusion, our means of cognizing a substance.

The evolution, in the individual, of a power of recognition of something which was previously unknown, must depend, therefore, upon the growth of a power of mind, or thought. A definition may allow one to identify an entity properly, but not to recognize it. For this we need something which unifies the list presented in the definition, and therefore identifies by inclusion rather than exclusion (the Latin root of define indicates a finishing, ending, setting limits; the Middle English usage was confined to fixing boundaries.) But we begin without this 'something,' and then come by it through reflecting on our experience. Our use of it in recognition is a type of skill, or at least the development of physical skill shows a number of parallel aspects; but this particular ability or skill is gained by a process that appears, to direct inspection, to be a strengthening of the activity of mind we call thinking.

One example of this strengthening or learning process is the effort put forward to recognize a plant species, or the even greater effort needed to recognize an entire family. When we attempt to get to know poison ivy, the study is restricted to the characteristic appearance of this one species. Fortunately, poison oak is so close that the ability to recognize the one will often be the ability to recognize the other. But other families of plants include members much more distant from each other. The orchid family, for instance, varies from rather splendid flowers to insect-catching pitcher plants. In order to familiarize oneself with this group, a comparison between three or four species is needed, at least one of which is very distant from one of the others. By searching out a commonality, a resemblance, we are able to form a perception of the quality, somewhat elusive at first glance, which characterizes the family.

One who has already recognized what is typical in the orchid group may facilitate our own recognition by pointing out what to look for, if he has any descriptive powers. A good characterization, no matter how metaphorical, will be useful to the learner. (Ezra Pound once mentioned that he had characterized Picasso's late cubism as possessing an "ice-block quality," and none of the artists he was talking with missed the point.) The task is to look _for_ the right thing, but this might just as well be phrased 'to get the right angle on it.' Having once gotten the proper aspect in focal consciousness, we seem to be able to return to it at will, and thus the _content_ of a helpful characterization would seem to be closely allied to, or perhaps actually _be_, the quality we are trying to see in the phenomena.

Because the power of art to characterize phenomena, or to provide ways of seeing, is very great, several writers have pointed out that in this sense, art may _make visible_, to its audience, some aspect of the world about them that they would otherwise have missed. Owen Barfield, arguing this thesis on the behalf of poetry, identified the activity of poetic evocation with that kind of intuitive thinking by which we recognize a _type_ in botany, while separating both from the operation of Linnaean identification:

> my experience in observation of apple-blossom is not much affected by my judgment that the tree before me is of the genus pyrus malus, which is of the order Rosaceae. All this judgment can do for me is to direct me to look out for a possible real resemblance between apple-blossom, pear-blossom, and roses, which, as it is intuited in actual observation, becomes poetic knowledge (inspiration), and will then react, as wisdom, on my further experience in observation (recognition), so that I shall truly see or 'read' the flowers with different eyes.[5]

He then proceeded to find the 'poetic principle' in the guidance of the primary synthesis of percepts, which, being itself prior to all discriminations, makes all discrimination possible:

> The poetic conducts an immediate conceptual synthesis of percepts...it meets, through the senses, the disjecta membra of a real world, and weaves them again into one real whole;[6]

thus fulfilling a function similar to that of the Kantian synthetic imagination.

If good characterization has the ability to 'open your eyes' to perceptions which might otherwise have remained unknown, then it would seem that Barfield must be at least partially correct, and Shelley's insistence that the poets discover "before unapprehended relations"[7] in nature, which were previously nothing for the mind, but now take up "a local habitation and a name," may be quite true. Effective characterization communicates something to the mind which has an image-making power, which allows us to find the character indicated in an immediate aisthesis. (An appreciative audience of poetry or prose fiction will sense this, if they do not directly realize it, and this is why Dickens' use of Bitzer's definition can have such satirical power—it stands, after all, in implicit contrast to Dickens' own art.) Whatever this content is, its making visible is also a making intelligible, or cognizable, and its affinity with thought-content is therefore obvious.

Because art is so concerned with concrete evocation (not merely naming, but calling up a presence, making the referent perceptible in some sense), a good deal of instruction for artistic creation has emphasized the state in which the artist must be, or the activity into which he must enter, in order to accomplish such evocation. The canons of Chinese and Japanese painting, for example, prescribe a strict language of conventions (types of shapes, washes, brush strokes) and designate their area of application (trees, rocks, animals, etc.), but yet warn that any art done by the guide of discursive rules will be utterly without value. In order to be guided properly, the artist must be inspired, and the content of the inspiration is taken from nature:

> The Japanese artist is taught that even to the placing of a dot in the eyeball of a tiger he must first feel the savage, cruel, feline character of the beast, and only under such influence should he apply the brush...should he depict a seacoast with its cliffs and moving waters, at the moment of putting the wave-bound rocks into the picture he must feel that they are being placed there to resist the fiercest movement of the ocean, while to the waves in turn he must give an irresistable power to carry all before them; thus, by this sentiment, called living movement (SEI DO), reality is imparted to the inanimate object.[8] [italics mine]

The reality spoken of is obviously not the physical presence of the things depicted, but it is a concrete presence. The power of evocation of such painting, even though executed entirely through conventions of brush usage, is extremely high. The qualities aimed at, the aspects of perception that the artist trains himself to produce, are none of them sensible, but rather intuitions that characterize the sensible entities, intentional stances that we may reenter through memory even though the object is no longer before us.

The strategy of training above has been part of western theory ever since Plotinus, but we may assume that a talented artist would discover it on his own without the need of textbooks. Georges Braque, interviewed at 70, was asked about his way of representing objects, and replied, referring to the particular quality he desired to bring out:

> all I have to do is look at it in a certain way... You just sort of project a magic ray on to an object and bring it into the enchanted circle.[9]

The Japanese artist was interested in the characteristics of nature, and was inventive only through his individual penetration into the generally recognized characters. Braque is self-consciously inventive, announcing a new way of looking, but in both cases the project is quite definitely a way of looking, and the training instructions are directives on clarifying and intensifying the artist's intentionality.

That content which is, for the artist, an image-making power, will have a similar application in empirical research. The possibility of extending the range of man's perception through the use of instruments supplimentary to his senses (telescope, microscope, etc.) has been recognized since the days of Galileo, but that the mind itself can, and must, be developed as an instrument of perception is less clearly understood. It is possible that, due to the correct recognition of a definite given in perception, the act of perception was taken as a simple task, to be performed naively, while the real intellectual work began after perception had taken place. But the case is almost opposite. The definite given in any appearance is the intentional structure, given in aisthesis, and its determination is therefore a function not only of the percept but also of the perceiver. Perception is primarily an intellectual task; the observer must think into his percepts in order to make his phenomena intelligible, and neither the artist nor the research scientist can afford to be content with the habitual perceptions of his culture, any more than the philosopher can rest with the habitual thought pattern.

The philosopher may work in words, but he may have some other means of representation for his concepts. The artist works, or thinks, in the medium of his art (which includes, not merely the physical medium, but any mode of symbolism available through it). The empiricist has, for his medium, the phenomenal world. Those who approach this world within a descriptive science, such as Goethe's, attempt to make their thinking sensible, to think through the phenomena, which are thereby recognized as representations. As would be the case with other forms of thought, the mental effort of the individual may deepen the meaning of known ideas, or bring forward new ones. But such a deepening or inventive activity depends upon a development of intentionality in the thinker, no matter what realm he works in, for this is where the image- or symbol-making power resides. The possibility of such a development calls forth, in empiricism, the notion of potential phenomena, appearances which are, to begin with, nothing for the mind, but which may become (without any appreciable change in the sensible percepts) through the mind's development. In a purely descriptive science, this movement from potential to actual phenomenality is the parallel to theoretical advance, and without it no progress is possible.

This advance is not, I should emphasize once more, an advance in explanation (in any ordinary sense of the term), in theory which is postulated about the phenomena, but in the intelligibility of the appearances themselves. This is why Goethe insisted that morphology

> nur darstellen, nicht erklären will... (is intended only to display, not to explain...)[10]

and is reflected in turn by Braque's comment, reported in the same interview, that

> There is only one thing in art that is worthwhile. It is that which cannot be explained.[11]

A good characterization never explains anything, but it does allow you to see more clearly, and therefore to cognize more in immediate reflection. In short, it actualizes a phenomenal potential that was previously latent, and advances the understanding in this manner.

But we need now an example of an intuitive concept, an image-making content, in order to understand how such content may be empirically isolated for the mind, and how it functions within actual perception. Our example in this paper has been the 'movement' of homologous forms, and we shall now return to it, examining this time the method of perceptual advance illustrated by Goethe's text.

(d) The dialectic of perception

I mentioned, in the last section of the preceeding chapter, that the guide we follow when constructing a homologous series is the 'movement' that becomes apparent between the forms. Any morphologist could have discovered this fact quite easily by inspection of his own processes of thought during construction. Yet many good ones, including Huxley, attempted to *explain* homology by suggesting that it was nothing more than the sharing of certain key features by all forms. They were thinking, evidently, of the impression, crucial to the recognition of homology, that the varied forms were yet one form. Yet this is an explanation that only a blind man should accept.

When we begin the construction of a series, we place two forms in juxtaposition, and then see the difference between in terms of 'movement.' If there was no difference whatsoever, of course, there could be no 'movement' either. But the above explanation would have us believe that the impression of unity derives from ignoring the differances and concentrating on the similarities, a procedure which would destroy the impression of alteration between the forms, and thus of the unity of the series. All explanations which depend upon a commonality of static form, of schema, will fall into this same difficulty, and it takes but a moment's reflection to see why. This moment, however, must focus upon what the observer is doing with the perceptual field, not simply on what he supposes to be there.

The commonality of the forms then, the impression of unity delivered to the mind, rests on the differences of the forms as much as on their similarity, since the unifying factor is the common, continuous transformation, and without these differences there could be no determination of change. If our series is such that the forms are close to each other (change in small increments), its transformation will be more visible, because it is more sensibly filled in, than would be the case if the intervals between forms were greater. Such a series of small increments will also be more definitely determined, in its gesture, than one of lorger intervals which leave more room for variation. But there must be some interval, some change between forms, if we are to see any transformation. A series of replicas of the same form would be an entirely different kind of grouping, a simple sum of many equal pieces. The unity we are interested in is of another composition. Let us look more closely at how this composition is found.

The two leaves on Plate XX are not very similar. Leaf #1, for example, looks something like a maple leaf, but #2 certainly does not, being too narrow and pointy. It is obvious, therefore, that we can take the two forms as relatively unrelated. They are both leaves, but they are very different leaves. Were I to compare the two at all, the difference is all I would be likely to register. On the other hand, if I turn back to Plates VIII A & B above, I shall find that I can also see a continuity. But then I am looking from another angle.

A similar change in the phenomenal picture was discussed above with regard to the two images on Plate XVI. The images could succeed one another without any alteration in the percept, the change being a function of the manner of representation. Even so, two leaves may be seen as discontinuous, or continuous, depending upon how we look.

In order to avoid confusion at this point, I must remind the reader that the actual visual appearances are what is seen, if this term is to have a consistant usage. A conclusion which must follow from the argument about perception in the last chapter, if accepted, is that there can be no one correct way to see the world. A multiplicity of structures may be found in the same sensible input, depending upon how we look at it, and each is to some degree valid if it can be seen. Thus we cannot give one structure of appearance primacy over another upon the basis of an assumption that only one way can be correct. If a structure can be perceived, it is there, for this is the only test.

We do not, therefore, take one appearance to be another. When I look at Plate XVI, I am neither looking at the image of an old woman and taking it as that of a young woman nor *vice versa*. Nor am I looking at the relatively neutral pattern of ink-blots and taking it as a young or old woman, for if I am seeing one of those images I am *not* seeing the neutral pattern, which is also a type of image, a particular structure of appearance. When I say that I took a cow to be a bush, while looking at the distant end of the meadow, I do not mean that I saw the appearance of a cow and took it for a bush, but that I made the appearance of a bush out of sensible stimuli that turned out, upon later investigation, to be orginating with a cow. But there is no way I could make a *seen*, and therefore recognized cow, into a bush.

Seeing is an intellectual task. *What* is seen is apparent only to the mind, the physical eye being neutral. To see is to attend to the visible appearance of *something*, even if this something is not yet recognized as something familiar. (As long as an appearance may be distinguished from other appearances, it is an appearance of some particular structure.) To attend to the appearance of something is therefore to attend to the appearance of determinations of structure in the sensible field, for without such determinations we would have no focus for mental attention. But nothing in this restricts us from finding more than one set of determinations in a given sensible field, and the only possible test of the determinations to be found there is the finding of them. Nor is there any possibility here that I could take one set of determinations for another, since these determinations, being the objects of mental attention, are intentional. If I intend X, and X is not Y, then I am not intending Y, and if I were, I should not be focussing upon X. I cannot take one determination for another for the very same reason that I cannot understand how two different things could have no differences between them—a determination is recognized through an intention of consciousness, and I cannot, within consciousness, make any sense of contradictory propositions.

If we return to the leaves on Plate XX, we find that while we look at them as quite unrelated forms, we do not find that structure of appearances which, in the second mode of viewing, makes them continuous. We are able, however, to find other structures, and these are quite distinct.

But while the two images on Plate XVI have an equal claim on the viewer, this is not really the case here. It is not incorrect to view the two leaves as quite unrelated, because they can be so viewed, but it is incomplete, and therefore inadequate. If we go past our first glance, for example, and sit down with the two leaves to examine them, we find that while they exhibit different structures, they also contain similar elements. For one thing, both are constructed on the same vein pattern. For another, the marginal indentations of #1 are always between veins, and the points on the vein, and this is exactly the case with #2. Each leaf has three main branches or extensions, but #2 might be said to have two minor ones as well, if the branches on either side of the stem are taken to be independent of the major branches. Of course, one might find something similar in the fact that the two lateral extensions of #1 might be taken to be composite ones, made of a major (higher) and minor (lower) branching, and thus some parallel could be established. And so on. We could continue, but we shall obviously end up with a great collection of both similarities and dissimilarities, criss-crossed and overlapping, which makes the situation rather complex. It is no longer adequate to view the two leaf forms as perfectly distinct: they are, but they are not; some aspects are quite distinct, others quite similar. It depends on what you pick out.

Thus close examination allows the original rather clear difference to become obscured with difficulties. Matters are not what they first seemed to be, but that is because our first view was too selective, emphasized only the differences and overlooked the thematic similarities. But now that we have picked out a number of both, it becomes rather difficult to see the relation of the leaves. We can easily relate one aspect of the total structure of one leaf to one aspect of the other, and get a clear contrast or agreement, but in doing this we cut up the totality into static parts, and do not get at the whole. The whole, however seems to be almost inexhaustible in the possibilities it submits for partitioning, and thus, should we attempt to compare all possible ways of slicing things, we should be at the task forever, for they are potentially infinite. (This is why Darwin discusses the difference between homologous forms in terms of "infinitely numerous modifications" in the quote above, p. 174. He has attempted to conceive the whole in terms of static parts.)

At this point, we are in need of a manner of representing which can include all the pieces we are turning up, or turning out. This requirement is filled by seeing the two leaves as transforms of one another (or by another solution which we will discuss shortly), for this single relation absorbs all the similarities and differences into itself, or rather, organizes them under one law. But in so doing, it seems to transform the differences we found into something else, for now they are part of the evidence of continuity, where before they obviously represented a discontinuity. Just so, for these structures are no longer static, and the two different static structures are now themselves transforms of one another; the narrow sections, for example, of #2 are but the correspondent sections of #1 grown narrow; the deep notches, approaching palmate compounding, of #2 are the shallow notches of #1 grown deeper, and so on. The features, upon comparison, no longer represent mere difference, but different appearances of the same thing.

Let us remember that this is a seen continuity, not a hypothetical one. When looked at in terms of transformation, the shallow notches resemble the deep ones, while they did not earlier. I mean to say that they visually resemble them, even as blue-red resembles orange-red (although this is a simpler resemblance). The similarity is seen; there is no reason to hypothesize about it. The seen differences have now become, therefore, seen resemblances. How is this possible?

Well, certainly this cannot mean that depth resembles shallowness, or shortness tallness, or any such obvious contradiction. But a shallow notch may resemble a deep one if the latter looks like a transform of the former. And it does not disappear in its shallowness, by this, but remains affirmed in the phenomenal structure. We still see it, and along with it, the depth of the other notch, but now the two taken together represent not mere difference, total discontinuity, to the mind, but a continuity of transformation, of gesture.

The result, by which two structures, dissimilar on one level, are found to be continuous on an emergent level, and are thereby both preserved (we still see the different depths of the notches) and negated (we no longer see discontinuity here), is exactly parallel to that result which Hegel, in his dialectic, calls an Aufhebung. (This term is itself a play on meanings, since the German term may mean either to preserve, store up, keep, put away, or to negate, abolish, repeal, annul, and Hegel gets both senses together in his usage: to preserve or keep on one level by negating or repealing on another.) The term had been used in the same sense, however, by Schiller in the Aesthetic Letters, when he had to explain how one could end the opposition of two contrary powers while preserving the powers themselves. (Letter #18) Goethe also made occasional use of it when he spoke of changing one's way of looking, negating one aspect in order to see another.

(c) The basis of the dialectic in the structure of representation

Because the elements seen in the static mode of viewing are not lost, through an alteration of mode to a dynamic one, but preserved in a transformed state, the truth of the less inclusive viewing will be preserved in the more inclusive, and the results of the latter cannot therefore contradict the results of the former. (The two images on Plate XVI are contradictory, but that is because they exist on the same level, and neither is more inclusive than the other.) But I have not yet presented the 'other solution' to the problem of the relation between the two leaves that I mentioned above.

Suppose leaf #1 were a maple leaf. Leaf #2, being a buttercup leaf, suddenly looks discontinuous again. Maple leaves just do not look like buttercup leaves, except accidently. That is, one leaf out of the series of buttercup leaves presented on Plates VIII A & B does resemble a maple leaf, but the rest do not. Does this contradict our results, since we have said that the maple-like leaf also resembles the rest of the buttercup leaves?

Well, we can understand that no two maple leaves may be exactly alike, but all will be characteristically alike. The same is true of buttercup leaves. Now when one maple leaf is taken out of its context, not identified as maple, and put into a series with buttercup leaves, it will, at least in silhouette, seem to fit there as well. Since leaf #1 is actually a buttercup leaf (I have not misrepresented), we can see that the same exchange could work in the opposite direction, and #1 at least could fit in a sequence of maple leaves. But when we were looking at the buttercup series, we would be attending to the structure characteristic of that plant. While looking at the maple leaves, we should be focussing on their characteristic structure.

Buttercup leaves have a certain range of transformation. It is almost complete on Plates VIII A & B, for I have never seen a greater range than this. Maple leaves also have such a range, but it is smaller, the distance of variation being a good deal less. Poison ivy, of course, also varies. The man who can recognize poison ivy, however, can recognize anything characteristic of its range of variation. The same is true with maple leaves, and again with buttercup. Well, but what is this variation? It is, in the case of buttercup, approximately the transformation seen in the leaves of our example. To know the whole range is to know this continuous variation, and to recognize an individual leaf as part of it, or its representative.

The reason that we may say that there is another solution to the problem of the relation between the two leaves above is that we need not include them in the same series, but might make them representatives of two very different series, buttercup and maple. If we look upon the forms in this manner, they are quite different, since the 'movements' of the two series are quite different, and they are each a part, and therefore a representative, of their respective 'movements.'

It would seem that we are not yet free of dialectical considerations. Our problem has now become a part-whole dichotomy, and specifically, how the whole can appear within, and determine, the part (which is, of course, the relation we need to understand to approach organic unity, or Schiller's theory of beauty). We shall understand this better if we remember that this is also the problem of how the individual form can be characterized as a representative of a more inclusive form, i.e., the type.

The solution lies before us already, in the manner in which one constructs the homologous series. As I remarked above, the guide is the emergent <u>gesture</u>. Thus, to put in a member, we must not only find a place for it, but also <u>look at it</u> in terms of 'movement' rather than stasis, and not just any 'movement,' but only that of the emergent <u>gesture</u> which is typical of the species. The new structure of appearances, now emergent (when a place in the 'movement' has been found for the otherwise static element), is clearly determined, not by the individual element <u>qua</u> individual, but by the <u>gesture</u> of the whole series. The element is now an arrested stage of that <u>gesture</u>, generated by its function of transformation, and therefore determined by it.

If the leaves of a series were taken as individuals, and the series looked on merely as an aggregate, no continuity would be seen between the parts of that aggregate. If we do see such a continuity, then we no longer have the same whole, since it is not an aggregate, nor the same parts, since they are no longer discontinuous. That is, in order to see the series as an aggregate, we must <u>not</u> see the continuity between the leaves. But if we do not see this, then we see discontinuity, which must be based upon difference. This difference, however, is the very difference that became resemblance through the dialectical negation discussed in the last section. We find, therefore, that the qualities which determine the relation of the leaves to each other have changed, and since these qualities are internal to the leaves, the leaves have changed as well— changed, that is, by becoming parts of a continuous transformation rather than parts of an aggregate, the part-whole relation of the two situations being quite different.

I said above that the leaves 'resemble' one another as members of a transformation in a manner that they do not when discontinuous. But what constitutes this resemblance? A shared structure, to be sure, but what structure? There is only one possible answer, and that is the <u>gesture</u> of transformation that flows through them. That is, in this particular case, the visual similarity that is added, by putting the individuals in the context of the series, is the appearance of the <u>gesture</u> <u>in</u> the individual; this is the new quality that it shares with its neighbor.

Of course, once the forms of the series are viewed as arrested stages in a continuous transformation, the similarity thereby gained will not be due to the arrest of the stage, but to its conformity to the flow of the gesture. It can represent something essentially dynamic, even while arrested, even as flow forms on the marbled papers that Thompson talks of can still 'flow,' while being but an arrested stage of the generating transformation. Even so the juxtaposition of the two forms on Plate XXI is a pointed one because the resemblance between the two forms depicted, a flow-form of water on sand and an oyster shell, makes us aware that we may view both after the same dynamic manner of representation. (It is to be expected that we should look at the imprint of flowing water on sand in terms of flow, but that we find a similar structure in the hard shell of the oyster is of particular interest.) We must take them as arrested stages of flow-forms, intuiting the 'forces' involved, or better, to avoid speculation on some sort of unrepresented, the tendencies of movement. It would seem that we should have little difficulty understanding how the static percept, through its structure, may represent flowing change to the mind.

A flow-form such as those on marbled papers will 'flow' whether or not it is in a series which reveals the subsequent forms. We represent, through it, the tendency to movement, the velocity vectors, which would continue its transformation. We see it therefore as part of a continuous transformation, for we have put it in that intentional context. The single form becomes a form which is 'going somewhere' when it is placed in the context of a graded series, because it is then representative of the transformation of the series, or when it is placed in the context of the gesture of that series whether or not the rest of the series is present. The gesture, which is an intuitive unity for the mind, is not built out of the parts of a series but rather generates them, as their law. As such, it may be the intentional context whether or not it is filled out by a sequence of forms.

This provides a whole-part structure in which the whole determines the part and appears within it, as expressed dynamism, or represented continuity. The part, the arrested stage, is here the representation, and the represented is the flow. If the viewer was to represent, through the stage, the particular gesture, and not merely a general sense of dynamism, then the representation so formed would as a result resemble any other representation of the same gesture, and of structure of appearances exemplary of the same law.

And thus we finally see why leaf #1, on Plate XX, could seem characteristically different from leaf #2. I said, in my first description of this situation, that it might be taken for a maple leaf. The characteristic shape of a maple leaf is not recognized from one leaf, but only from a sophistication gained from exposure to many; to the whole range, as I called it, of the maple. But what is this range but a form of gesture, that characteristic to the tree. By taking it to be a maple, therefore, we set it in the intentional context, the gesture, by which the trained eye sees the typical similarity of maple leaf. Because it fits (in silhouette only, and perhaps only roughly at that), that is, because it allows us to see (represent) that gesture appearing in it, it now resembles, not buttercup leaves, but only maple leaves, since we are now speaking of typical resemblance.

Goethe's type is therefore, at least on the first level on which any such entity appears, a gestural context—an intentional content for the mind, and by this an idea (although intuitive), but also an apparent structure in the phenomena, and by this (since it is an idea as well) a law. It is absolutely constituitive of the phenomenal appearances, for without it these appearances could not be seen. The manner in which they are seen has been reviewed here.

(f) Method

We are now in a position to review Goethe's general approach rather briefly from his own remarks. We shall find in it a very pure empiricism, which may come closer to realizing the goal of finding the theory in the phenomena than any other approach.

The reader will remember that in Goethe's age the tension between rationalism and empiricism was not yet mediated. Reid had made a neglected contribution in Scotland, Kant had published his Critiques, but few could yet make use of them. Fichte, Schelling and Hegel began to publish only late in Goethe's lifetime. Thus, due to the lack of the historical mediations, the benefit of which we now enjoy, rationalism and empiricism could polarize to a great distance, making both rather unreflective. Goethe was particularly annoyed with what he called 'crude empiricism,' since advocates of this school insisted, on the one hand, that we should find all in the phenomena, but on the other, as the necessary compliment, that we should not theorize. Goethe replied that, due to the very close connection between intentional content (which he focused upon by 'reflection') and idea content (which he abstracted from appearances as 'theory'), these directions were the result of a confused view of the situation:

> It is an odd demand indeed, that is sometimes made, and not lived up to even by those who make it: They want you to report what you experience without any suggestion of a theoretical slant. It is to be left to the reader, the pupil, to work out a pattern according to his pleasure; for merely to look at a thing does not result in benefit. The activity of looking passes over into contemplation; contemplation leads to reflection; reflection brings forth a network of relationships. Thus one can say that every time we attentively open our eyes to the world we get engaged in theorizing. But to theorize consciously, on the basis of self-knowledge, with freedom, and, I would even venture to say, with irony— what adroitness is needed if the resulting abstraction, which we are afraid of, is to be innocuous, and the yield in cognition, which we hope for, is to become truly alive and useful![12]

Theorizing, which at its best is simply abstracting a network of relations from the phenomena, will be done by the astute with self-knowledge and with <u>irony</u>!—self-knowledge, because we must understand what the mind is doing with the evidence if we are to understand the nature of its results; irony, because the recognized structure of appearances may transform with further appearances, though the truth of an earlier structure is quite real. Hegel's discussion of Newtonian gravity, for example (Philosophy of Nature), makes a strong case for seeing that notion as a metamorphosis of the Aristotelian notion, and therefore a preservation by negation of the theory of the 'proper place.' Had we no sense of irony about our postulations their transformation would never be possible.

Unfortunately, the usual 'theory' is nothing like the Goethean ideal, but is rather a speculative foray into the unrepresented, made without an understanding of its nature, and before the structure of appearances is clear enough to comprehend:

> Theories are as a rule impulsive reactions of an over-hasty understanding which would have done with phenomena and therefore substitute images, concepts, or even words in their place.[13]

A scientific hypothesis, on the other hand, would be to Goethe's mind, a speculation, not about the unrepresented, but about possible appearances. It would postulate a structure of appearances which had not, as yet, been actually found (by aisthesis), but which could presumably be found upon further investigation. It would be constructed by a speculative extension of patterns found in past experience, and seek after confirmation in future experience.

It is most important to realize that Goethe's intention was to avoid, if possible, any statement about the unrepresented. This is not the usual notion of hypothesis, nor will the usual notions of induction apply to it. A hypothesis which postulates a particular structure of appearances is clearly confirmable (by finding the structure in question in the phenomena), and the problems which are generated by the split between a representation and the underlying unrepresented do not arise with regard to it. The reader must bear in mind, from this point forward, what sort of 'hypothesis' we are speaking of.

Of course, even if a hypothesis is in principle confirmable, it is still speculative; a thought structure rather than a perceived one. For this reason it remains a somewhat dangerous substitute for actual perception, and must only be used as a device by which to seek such perception. It is not the same as the final theory, but rather a temporary guide to observation:

> Hypotheses are scaffoldings that one erects in advance of the building, and that one takes down when the building is finished. The worker cannot do without them. But he must be careful not to mistake the scaffolding for the building.[14]

Since it is an abstract entity, a mere thought-creation, the hypothesis must never be allowed to get in the way of the phenomena. It provides an angle of viewing, but if we become fond of it, it begins to blind us to other angles:

> All hypotheses get in the way of the anathoorismus— the urge to look again, to contemplate the objects, the phenomena in question, from all angles.[15]

The real advance in theory is not a hypothetical advance, although the practice of hypothesizing aids its realization, but an advance in seeing. The scientist's job, in a descriptive science, is to discover the structure of appearances, and he can only do that by making it perceptually apparent. Since this will mean being able to represent the particular phenomena in the context of the general, it means as well being able to represent, by the phenomena, an idea:

> Phenomena, also called facts in lay language, are certain and definite by nature, but often appear indefinite and variable as they meet the eye. The scientist attempts to grasp and hold fast what is definite in the phenomena; in individual cases he is concerned not only with their actual but with their ideal appearance.[16]

This ideal appearance is possible to find by becoming self-conscious of one's own intentionality— able to focus upon the synthetic principles by which the structure of appearances is governed. The dialectic of perception makes this structure self-reflective by making it appear <u>in</u> the phenomena:

> The object of our work would then be to demonstrate: (1) the <u>empirical phenomenon</u>, of which every individual is conscious in Nature and which is later elevated into (2) a <u>scientific phenomenon</u> by experimentation, by representing it under circumstances and conditions differing from those in which we first encountered it, and in a more or less effective sequence; and (3) the <u>pure phenomenon</u> now standing forth as the result of all experiences and experiments. It can never be isolated, appearing as it does in a constant succession of forms. In order to describe it, the human intellect determines the empirically variable, excludes the accidental, separates the impure, unravels the tangled, even discovers the unknown.[17]

The pure phenomenon is not a particular phenomenon, but a law governing the structure of many. As such, it can only be reflectively seen, i.e., is like the gesture which runs through a series of forms and is therefore visible through them, but not sensible in itself:

> the observer never sees the pure phenomenon with his eyes, [18]

but only through the objects he can see:

> Effects we can perceive, and a complete history of those effects would, in fact, sufficiently define the thing itself. We should try in vain to describe a man's character, but let his acts be collected and an idea of his character is presented to us.[19]

Unfortunately, since the actual theory is within the phenomena themselves, it cannot be seen there unless the viewer is able to find the proper intentional stance (and then to become self-conscious of that stance). One cannot prove such theory to anyone. Good characterization may lead another mind to the same appearances, but if it does not, there is no way to deduce the theory from what that mind can see. One must be able to intend a structure before one sees it, and this ability may not be present. If it is not, it is quite useless to attempt to argue the case.

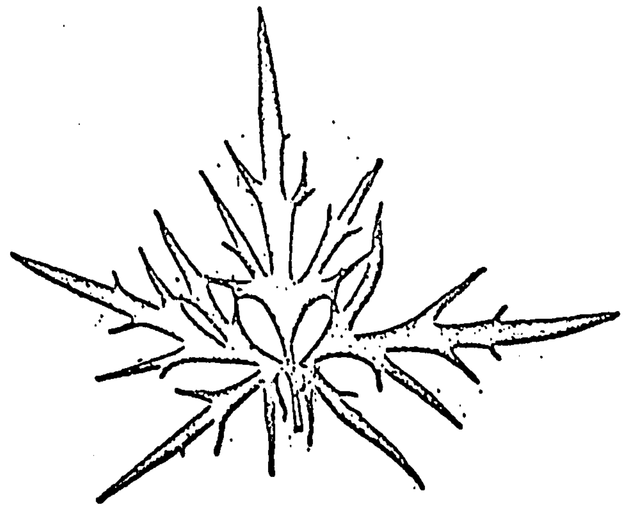
> An idea can never be demonstrated empirically, nor can it actually be proved. An individual not in possession of it will never catch sight of it with the physical eye. The individual who does possess it, easily trains himself to look beyond outer appearances, although returning to reality,

> after this diastole, to reorient himself. It is possible that he might follow this alternating procedure throughout his life.[20]

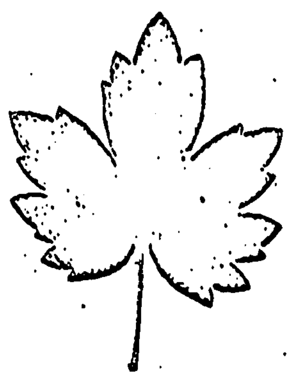
(*Reality* is here, in Goethe's characteristic usage, the sensibly tangible, a pole which has for its opposite *ideality*, the intuitive content which can be contemplated in itself only through 'inner beholding.' The actual meaning of the 'return' above is not, obviously, a return to the *purely* sensible, but rather to sensible appearances as they meet the eye when we 'start over' after abandoning the highly self-reflective stance we had formerly reached. Meanwhile, of course, the sensible appearances have probably evolved— I have never, for instance, been able to see poison ivy as I once did, *without* its characteristic appearance, since I learned that appearance.)

Morphology does not compete, Goethe was fond of saying, with other sciences. It has its own place and its own problems. (The reflections on scientific method than an epistemological concern with morphology brings forth may indeed force a critical re-estimation of other scientific epistemologies, but this is another matter.) It is concerned with generally recognizable entities, and makes its whole task the penetration into the structure of appearances recognized. This goal was rarely understood by the scientists who undertook a criticism of Goethe's work, even to this day.

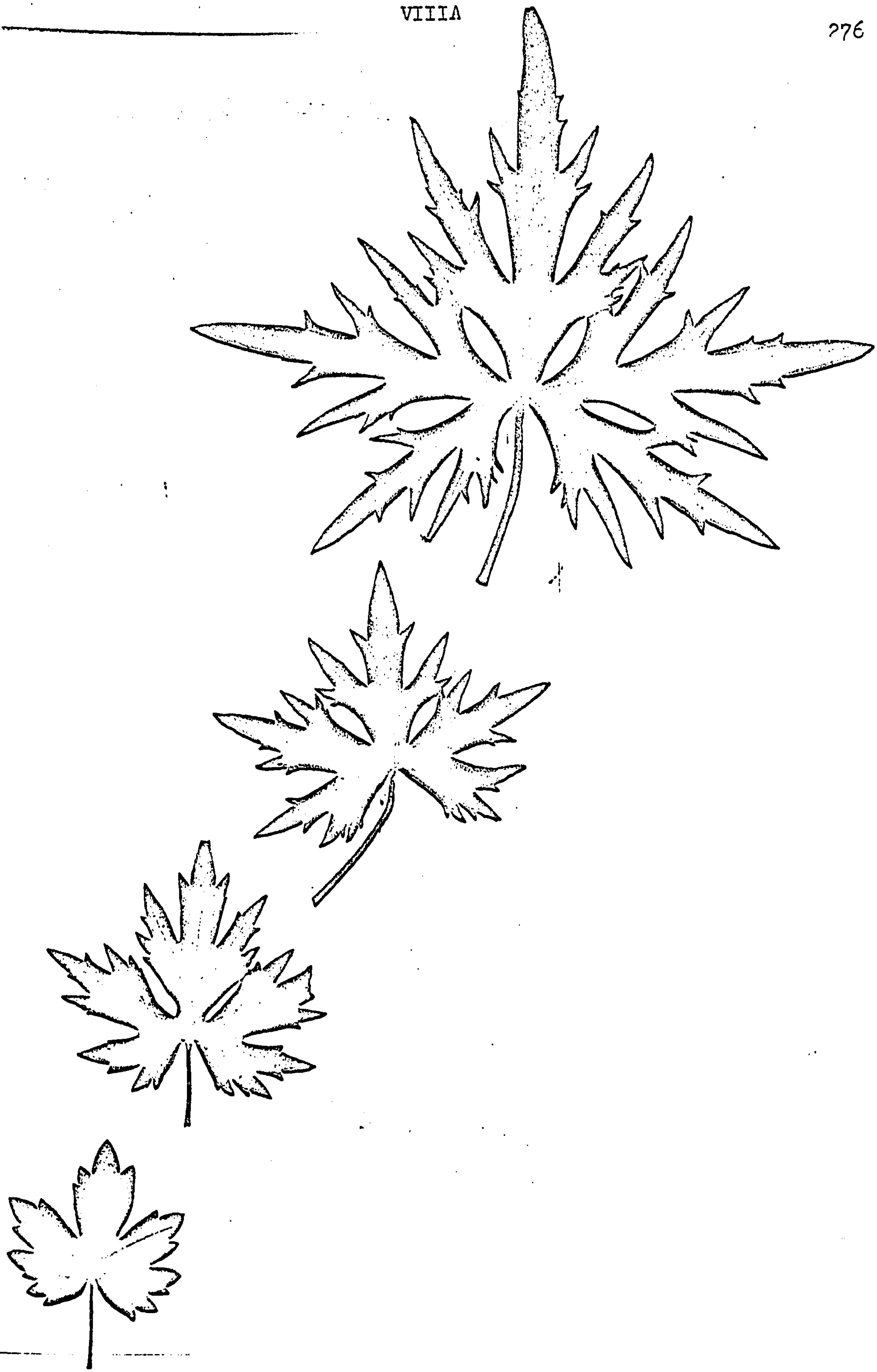
One still finds, in the modern literature, the comment that Goethe's 'artificial schema' of contraction-expansion, by which the plant is supposed to progress, has been proven wrong by physiological studies. This betrays a complete misreading of the text. Physiological evidence could have no bearing on the claim whatsoever. Goethe did not claim, for instance, that some sort of physical contraction of the stem phase produced the calyx. He gave no causal explanation at all. His point was limited to _how_ the forms involved were related, not _why_. So he tells us that we could transform the stem phase into a calyx by a contractive transformation, and thus the calyx was related to the stem through a _gesture_ which, moving from stem to calyx, contracts. Through the analysis we discover that stem and calyx are not discontinuous organs, but are actually transforms of one another, united by a particular function of transformation. Thus the opposition between the uniqueness of the forms (seemingly discontinuous) and their continuity (both vegetable and leaf-like figures), is resolved, and we discover the underlying unity behind these opposing aspects. But this is entirely a matter of seen structure and offers no causal explanation. Contrary to the usual crtical opinion, Goethe's remarks are not a speculation about an unrepresented.

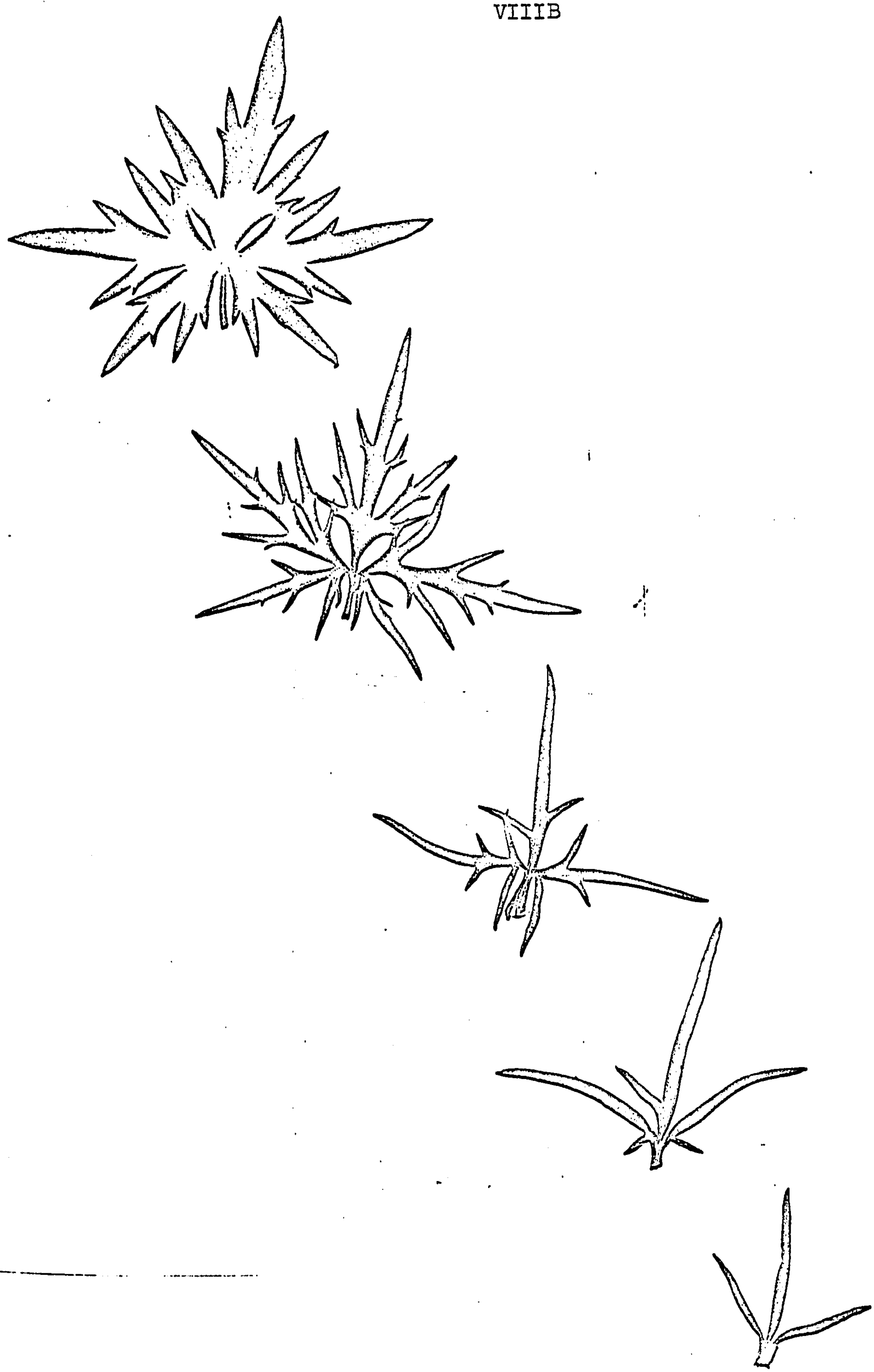


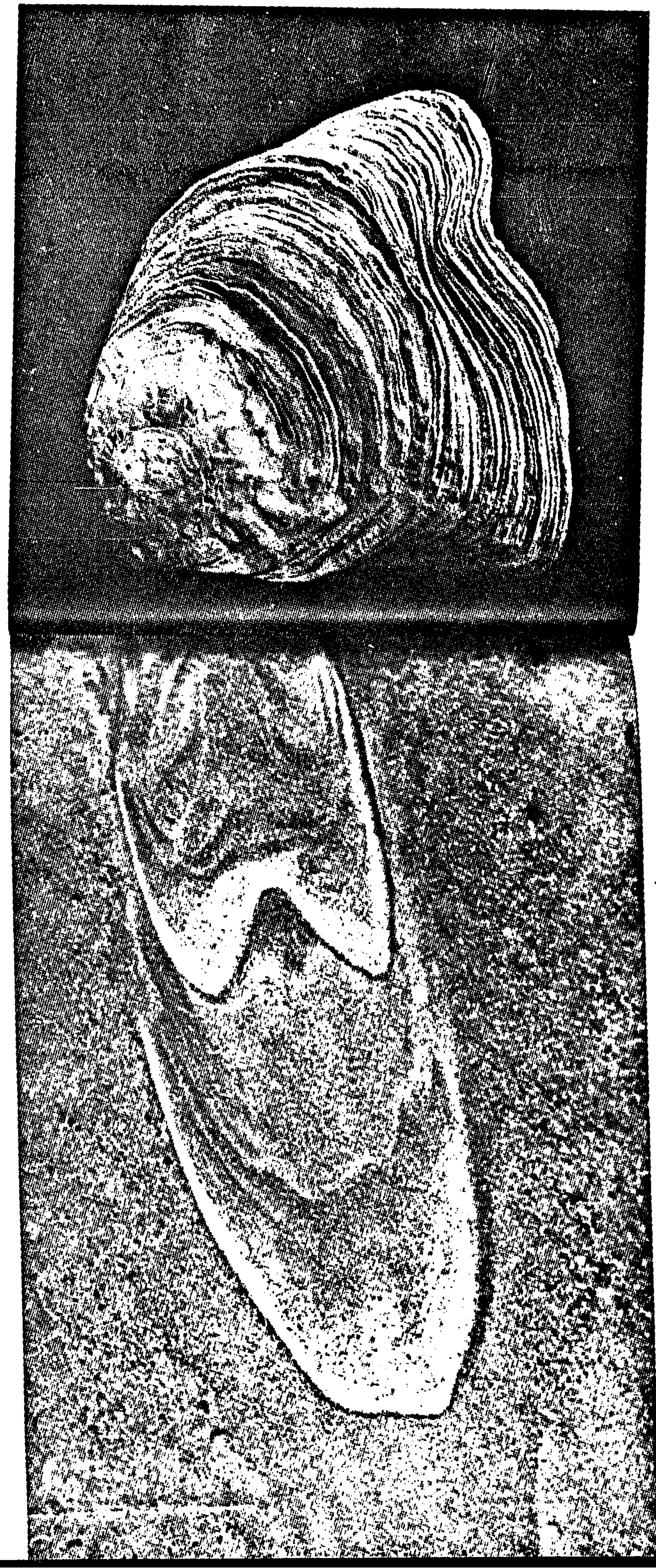
2



1







V Morphology and Aesthetics

The reader who has had Schiller's discussion of beauty in the Kalliasbriefe in the back of his mind during our tour through Goethean morphology will have recognized the crucial points of contact. We may now see just how valuable Schiller's contribution was, for it will no longer seem merely a speculative addition to Kant's third Critique, or an idealistic theory that we may profitably ignore when turning to 'get down to the facts.'

A science of aesthetics would be a science of appearances as well as of psychology, and in that respect a descriptive science. The 'facts' are, as Goethe mentioned, phenomena, perceived appearances, and these do not remain fixed but are quite capable of evolution. When they are carefully studied, the means and manner of this evolution will become apparent.

(a) The aesthetics of Schiller

When Schiller attempted to explain what he meant by

> Beauty is nothing else but freedom in appearance[1]

he was hampered by the lack of an empirical demonstration of the structure he wanted to point out. His Kantian background presented an immediate theoretical barrier, because while

> Freedom in appearance is nothing else but the self-determination of a thing, insofar as it reveals itself in intuition, [perceptually][2]

the determinant of structure, for the mind, was the concept (rule); but the concepts that determined empiric appearances, according to Kant, were all, like those of mechanics, external to the object, forming connections between objects. They legislate, as universal laws, from the outside as it were, and by doing so remove all possibility of self-governance. Sensible objects are therefore determined (caused) by other objects or events (prior circumstances), and the ground of the possibility of an object never falls within that object. Not a useful result when one is searching for "that which is not determined from the outside..."[3]

He needed, therefore, an inner 'rule,' something which would be found internal to the object itself rather than in its relation with others:

> The object must possess and show such form as admits of a rule...One need only view a single tree-leaf and the impossibility that the diversity of these has been able to order itself by accident or without some rule presses upon him...[4]

If an inner determinant or rule could not be found, it became obvious that no such structure of appearance as "freedom in appearance" could be possible. But the mind could see determination only through the concept, and this, being a universal which supplied the connections between objects, was just the opposite of the desired determinate:

> every concept is something external, over against the object...[5]

Schiller was aware, from his own experience, that in some cases we can _see_ lawfulness without being able to explain it. The mentioned example of the tree-leaves is such a case, and there are others. To see law, however, is to see determination, even if one cannot be sure of _what_ law he is seeing, and thus there is in nature a type of structure that reveals determination without the aid of a Kantian concept. Schiller decided that beautiful form was an intensification of just this arrangement:

> One may say therefore that the beautiful is a form which _demands no explanation_, or which _clarifys itself without a concept_.[6]

Such a sense of determination could some only from

> the inner principle of existence of a thing, or conjointly, when considered as the ground of a form: the inner necessity of the form.[7]

but we must remember that this is but a structure of appearance, not a causal determinate for the real existence of the object. Once we restrict ourselves to appearances only, to the seeming of things, we are aware that such principles, at least as structural principles, seem to exist, and we find the many natural objects appear to be so determined, i.e., from an inner essence.

The task of the artist, therefore, is to strengthen this appearance, make this appearance even more pronounced than it usually is when it occurs naturally. The artist will endeavor, then, to borrow something from Nature and intensify it. Art presents Nature in the light of

> the pure harmony of the inner essence with the form, a rule which is both given and observed by the thing itself.[8]

and here Schiller halts, at least until writing the second version of the Aesthetic Letters.

We must recognize that if the structure of appearance that Schiller postulates is actually possible, it would be of great import to aesthetic theory, although its relation to beauty could not be determined without investigation. If no such structure is possible, of course, then the whole suggestion can be profitably forgotten. The primary question, then, will be whether his description of appearances is accurate, and this is an empiric question.

But we can understand, having come this far, that the structure in question does indeed exist, for we have an example of it in the 'rule' of a homologous series, which is both given by the objects (emerging from their juxtaposition) and obeyed by them (it is the determining intentional context in and through which the object becomes visible). And this is, of course, but a single example of the structure, which, as a general law, may be termed the relation between the representational part, or parts, and the represented intuition of the whole. It is present whenever the recognized object has such a structure of appearances as may be revealed to be constituted, internally, by more than the addition of the sensible properties, and this is often the case, just as Schiller suggested.

Whatever else aesthetics may be, it is certainly a study of the way in which appearances represent, or symbolize, some content. Schiller has argued that the structure of phenomenal appearances may be such that a harmony is established between two aspects of that structure, and the perception of this harmony he equates with the perception of beauty. This brings up a further question which we are not in a position to answer. Schiller's study of appearances does indeed belong to Aesthetics, especially since the evidence offered by Goethe's Morphology demonstrates the existence of just that structure required by his theory. But his conclusion that this structure is the phenomenal foundation of beauty is not demonstrated by the mere possibility of a harmony between inner and outer form.

In order to establish such a conclusion, we should have to demonstrate that aesthetic pleasure, at least, was the necessary response to the perception of inner-to-outer harmony. But this would give us the problem of defining aesthetic pleasure, and so on. It is perhaps better to drop the notion of beauty altogether and work in the opposite direction. This investigation has so far established, by empirical studies, the existence of a particular structure of phenomenal appearances. The next step in this progression, at least for the purpose of aesthetic theory, would be the examination of the coherence between inner and outer form. Schiller's thesis requires that this relation is, in some sense, a matter of degree. The 'harmony' may be greater, in some cases, and less in others. If this is so, then the end of the spectrum of particular interest is that at which the harmony is at its greatest. Here we should like to ask what quality this increase in coherence of structures has for the percipient mind. In proceeding by this method, we avoid the assumptive base of aesthetic 'systems' while covering the crucial ground.

Empirical study is, as the reader has reason to know, a long and patient business. I cannot perform the suggested examination here; such work is obviously a future task. But because Goethe's remarks treat the next step, they are of immediate interest.

(b) Goethe's aesthetics

Returning to the remarks quoted in Part I, we find a rather obscure statement about the relation between natural law and beauty:

> The beautiful is a manifestation of the secret laws of Nature which, without this appearance, would remain forever hidden.[9]

Having studied Goethe's notion of law, we know why it may be said to appear. But why should the beautiful be the key to this appearance?

Goethe will term a law of Nature an intention (Absicht: intention, purpose, goal) on occasion, particularly when he wants to indicate a distance between the law and its realization in the sensible. (He also will speak of the observer's 'intellectual participation' in the natural intention, thus capturing rather subtly the modern notion of the observer's intentionality by the same locution.) The law behind the oak tree, for example, is always the same, but the individual trees differ, not merely among themselves, but in the degree to which they bring the law to manifestation:

> Her intentions [Nature's] are always good, but not so the conditions necessary to make these manifest. The oak, for instance, is a tree that can be very beautiful. But what a favorable juncture of circumstances is required before Nature succeeds for once in producing a truly beautiful specimen![10]

The law may be more directly, or less directly, manifested, it would seem, and beauty lies at one end of this spectrum:

> The law, which comes into manifestation in the greatest freedom and according to its own conditions, brings forward the objectively beautiful... 11

Goethe is obviously in close agreement with Schiller on this matter, but he approaches it from a different angle, thinking, as he does, in terms of his empirical studies. He has noticed two ways, in particular, in which the empiric object may fall short of fully manifesting its inner determinant: (1) the species of organism may manifest only part of the potential continued within the general law, i.e., the fern is governed by the same 'vegetable law' as the rose, and its leaf is homologous with the rose-leaf, but it has nothing more than leaf and spores, while the rose has calyx, flower, reproductive organs, and fruit—the fern species is therefore a relatively incomplete manifestation of the law; (2) the individual may not come up to the potential of its species, as is the case with most oak trees. The complaint in the first case is self-explanatory. In the second case we must remember the difference between a fully developed and a stunted specimen. Here we have the simplest example of what is meant.

The species will remain what it is, but the individual may be bettered. A good gardener may bring a sick seedling back to health, thus assuring that it will grow into a 'more beautiful specimen' than would otherwise have been the case. We all know what this means, although it must be admitted that this is a very particular use of the term 'beautiful.' It refers to the isolated beauty of the single plant, for example, with no reference to its surroundings, and it is clearly based on just the notion that a fuller realization of potential leads to greater beauty. If we would be more cautious about the notion of beauty, in regard to the situation, we can at least note that the more fully realized specimen is more impressive, whatever the source of this power.

The gardener, then, does in a small way, in the realm of living plants, what the artist seeks to do in a larger, in the realm of man-made representations. The gardener is restricted to the organisms as they are in Nature. The artist, however, may go beyond this, at least in appearances, for he is constructing only an illusion of sorts, and therefore does not suffer from the material restrictions that are enforced everywhere in the natural order. Optimum conditions for growth, for animals and plants alike, are nowhere to be found. This is likely to be true for optimum health as well, and perhaps internal organization (one wonders whether we might not be better off, in our age, without the troublesome appendix). But when the artist selects a subject, he lifts it beyond the natural order, frees it from the restrictions that were inherent in that order, selects those aspects that caught his attention and motivated his selection, and freely evolves these appearances towards a fuller realization:

> When the artist selects a subject from nature, the subject is no longer under nature's jurisdiction. One can say, in fact, that the artist creates the subject at that moment when its significant, characteristic, interesting features dawn upon him— at the moment, I should say, when

he endows the subject with higher value.[12]

We are reminded of Braque's magic ray. This is indeed a similar situation, but here the ray will be quite definitely a discovered intention of nature, an inner determinant which can be carried further, in its realization, that has been the case:

> Plenty of masterpieces have been found, in which the Greek artists, in representing animals, have not only equalled, but far surpassed nature. Even the English, who understand horses better than any nation in the world, are compelled to acknowledge that there exist two antique heads of horses more perfect in their form than those of any race now on earth.
>
> Those heads are from the best Greek period; and our astonishment at such works ought not to lead us to infer that the artists copied from a more perfect nature than we have now. Rather, they themselves had become of some value in the progress of art, so that they confronted nature with their own personal greatness...
>
> Our worthy artists who imitate the old German school know nothing of this; they imitate nature with their own weakness and artistic incapacity, and fancy they are doing something. They stand below nature. But whoever will produce anything great must have so improved his culture that, like the Greeks, he can elevate the trivial actualities of nature to the level of his own mind, and really carry out what remains a mere intention in natural phenomena— from either internal weakness or external obstacles.[13]

To go into what Goethe means by horse-heads that are more perfectly realized would be to undertake a long investigation indeed. He is speaking mainly of bone structure, and as far as I have been able to determine by his references to classic art, and particularly horse-heads, in other places, he means that the proportions of the skull are more fully developed. But criteria used for animal development are not the same as those used for plants. Like the Japanese artist, Goethe will insist that the proportions of a horse-head should be so developed as to express the _character_ of the animal. This is not merely skeletal type. The character of the lion, for example, is leonine, the cow is bovine, and so on. Natural development has manifested these intentions, but not to the degree possible in artistic presentation. (In Chinese theory, the characteristic gesture of a brush stroke, or painted form, is governed by _Chi_, a sort of flowing spirit, but the essenses of animal character derive from another principle, the _Li_, which contains the leonine, bovine, canine, and all the rest. Much of ancient criticism was conceived in terms of the question: how well does the _Chi_ of the painting— the gestural element— express the _Li_? Since Goethe understands skeletal proportion in terms of _gesture_ rather than stasis, it must follow that _gesture_, like its human counterpart, may manifest an expressive component that goes beyond itself.)

We begin to gather, then, a sense of the manner in which the harmony between inner and outer form can be improved, in Goethe's theory, by the handling of the artist. In a very simple way we can all perform a similar action. A straight line, for example, drawn first in dry sand, then in wet, then on a blackboard, and finally with drafting equipment, becomes progressively more visible. The mark in the sand was, of course, _as a mark_, perhaps even more visible than the one made by a fine drafting point, but _as a straight line_, it is more visible in the latter case. There is a poverty of determination in this example when it is compared to the determinations even in a single leaf, but it suffices to reveal, in principle, the sort of development indicated. It is difficult to describe, in words, just what has happened in the progression mentioned above, but one way of putting it would be to say that the sensible was made to conform more closely to the intention, with the limit being that the sensible disappears altogether.

There is another way to illuminate the first line in the dry sand besides perceptually transforming it. One could speak about it, telling the observer what was to be signified by it. This would perhaps, however, lead to his taking it as a sign which stood for instead of an aisthesis of the desired content. Carefully worded directives for seeing the lines, however, would also be able to make its meaning clear, and this time without reference to geometric definition; i.e., we could characterize the phenomenon we wanted our observer to see. In this difference of approaches, I mean between the verbal characterization and resultant intentional stance, and the progression of drawings, we find a major difference between science and art (plastic arts).

Science does not attempt to alter the sensible contribution in order to make it conform to a law (hopefully), but rather to view the sensible in such a manner as to make apparent, perhaps by the combination of several examples, the laws to which it conforms. Art, however, actually alters the sensible in order to make the appearance of law in the sensible manifest. Thus what science can reveal through many comparisons, art may <u>show</u> in a single instance. This is why

> When Nature begins to reveal her manifest mystery to a man, he feels an irresistable longing for her worthiest interpreter— art.[14]

and also why beauty, if this increases proportionately to the coherence of the inner (intentional) and outer (sensible), may be said to reveal the laws of nature.

I mentioned, in the preceeding chapter, that the intentional content seemed to possess an image-making power. According to the analysis made there, an <u>image</u> is always <u>of</u> something, and therefore portrays a determined structure. We can see, in the example of the progression of drawings of straight lines, some evidence of the power of intentional content to <u>make visible</u>. It is, of course, the <u>line</u> which is becoming more visible, and it is therefore our determined structure. It is made visible by taking something away rather than adding it, at least in terms of sensations, but the cruder our line was drawn, the less determined the perceptual mark was, and thus what was taken away was an indeterminate excess. Crudity in drawing means, of course, just lack of determination, and therefore lack of visibility of the determined. It may be there, but it is seen through a glass darkly when the execution is crude. It is the task of the descriptive scientist to master the determined structure even through the crude execution, while the task of art is to improve the execution, and both are made possible, and necessary, by the distance in nature between intention and execution.

There remain, for future investigation, two very important areas of inquiry. One will be the structure of representation beyond that of gesture: how is such unity as the leonine or the bovine represented, and does gesture form, as Chinese and Japanese theory claims, a part of such representation? A second will be the all important distance between intention and execution. How is it to be understood in specific cases? What is the effect, upon the mind, of a decrease in this distance relative to what the mind has been contemplating? These questions may be carried out empirically, some form of Morphology being the tool needed to do so.

Lest the reader make an error concerning Goethe's relation to certain other camps of aesthetic theory, let me add a note upon two opposite tendencies which would both, for Goethe, be erroneous. The first position is that of Hegel's Idealism, which values in artistic representation only the idea, and therefore makes it the source of beauty and the final goal of art. Goethe was horrified with this suggestion, and never ceased emphasizing that the goal of art could not be found in a mere universal, but only in the particular:

> the highest, indeed the only, function of both nature and art is the creation of form, and within the realm of forms the aim is specification...[15]
>
> It makes a great deal of difference whether the poet seeks the special in the general or whether he views the general within the special...the latter is essentially of the nature of poetry... Whoever captures the special in the flesh gets the general along with it...[16]
>
> No art can do without sensuous appeal...where the

> artist tried to move in a higher region and approach the sphere of the ideal, it is difficult to provide enough sensuous content, and the treatment is apt to be dry and chilling.[17]

Though it may seem paradoxical, the general, the intentional context, serves to determine and therefore to specify structure, not to generalize upon it. The gesture of a homologous series, for example, made each member of the series a different individual, although of the same type, for it generated the difference between each individual by transformation. Art may seek the idea therefore, and science also, but this is for the sake of dealing with the particular, the perceived object. Aisthesis is always particular.

We should not think that Goethe, like Hegel (or Schelling) saw art as bringing the idea into the sensible. This would be a very stilted type of allegory. If this sort of description is to be made, then we should have to say that Goethe saw art as bringing the sensible into the condition of the idea. This is a bit more difficult, but a good deal more accurate. The problem of art, once given its subject, is one of execution.

The polar opposite of the Idealist position is not that of the sensualist, since he is not concerned with artistic theory, but that of the photographic realist. This is a position that must still be taken quite seriously since it is still very much with us (in the new drama, for instance, which has gone so far in this direction that it no longer attempts to represent appearances, but allows the actors to 'be themselves').

Goethe's insistence on the specific, the particular, must not be taken to be a demand for the crudely determined particulars of nature:

> It is the highest task of every art to employ appearance to create an illusion of higher reality. But it is a false endeavor to carry the realization of appearance to such a point as to leave nothing in the end but ordinary reality.[18]

(The term appearance here is used to indicate the appearance of recognizable surroundings.) One must, in a sense, imitate the world that the audience knows, in order to have something to work with. But one must also imitate a higher reality, which was the goal of the project from the beginning. Recognizable particulars must appear, but we should want to transform them, to manifest the underlying law. Idealization of the portrayed objects is therefore not only desirable, it is a goal in itself.

We could perhaps make use of an example, for the sake of clarification of Goethe's position. Goethe's art criticism dealt with a plastic style that we should find fairly realistic today, after the breakdown of realism and natural form which took place around the turn of the century. Modern sculpture, for instance, is said to begin with the Paris works of Constantin Brancusi, whose abstractions gave rise to a new freedom in sculptural representation. We hear of Brancusi that he simplified to the point at which the object was barely recognizable, reduced it to its essence, and idealized. All these judgments are true if understood correctly, but for that very reason Brancusi, who began from nature and simplified natural forms, makes a more striking example of Goethe's precepts (which the artist never mentioned).

Plate XXII presents a photograph of a Brancusi sculpture. It is done in polished marble, about as big as a cantelope, and as the reader can see it is a very simple form indeed. The basic shape is similar to that of an egg. One section of the surface has been lowered, so that it does not meet the upper surface, but generates a verticle plane of a crescent shape. The narrow end of the egg has been partially sliced off, producing another plane which is interrupted only by a small nubbin at the base which was retained from the original volume of the egg's shape. The unseen surface of the egg is quite smooth and without any further articulations. It is titled: The Newborn.

Surely art has left nature far behind with such a piece, and at first glance it may be difficult to pick any natural form from which the shape could have been abstracted. Some critics, writing of the work without a knowledge of its context, have been content to offer that the simplicity of the form suggests the egg, the barely formed, and therefore the newly created. Those who know the rest of Brancusi's work, however, can make no such error. The following plate presents the same theme in an earlier version, and a late bronze of the theme for comparison. The early version is titled The First Cry, and is clearly abstracted from the head of a human child. We can see a suggestion of the ear (lower left), a stylized eyebrow and nose (the crescent plane), and the open mouth of the infant. Glancing down to the later bronze, we see that the ear is completely gone, the crescent is smoother, and the opening of the mouth has been replaced by the plane of truncation on the narrow end of the egg.

Discussing the difference in execution between the Newborn and the First Cry, Sidney Geist writes:

> The marble [Plate XXII] simplifies radically the work in wood [an early First Cry], reducing the number of elements and places; the eye and mouth, sunken into the mass of The First Cry, are realized here by the subtler means of a shift of the surface. But the relieved nose, evident in wood, is retained in the marble. The Newborn is less imitative of nature even than The First Cry, and creates a human image by relating very few abstract elements.[19]

This is a reasonable report on the situation, but it is unable to penetrate very far into the determinations of the image formed. To speak of abstraction in this manner (or stylization or idealization), is to give a mere suggestion of the process by which the result is obtained, and perhaps to obscure the viewer's own seeing of that image. A very elementary morphological examination will put us on firmer ground.

When we move from the First Cry to the Newborn, we move away from that imitation of nature which Goethe terms, in the quote above, "the realization of appearance," i.e., the imitation of common appearance, and move toward what he terms "an illusion of higher reality" or, in his terms, higher specification. We abstract from ordinary appearances, therefore, but we do not, because of this, come closer to the nature of an abstract idea, losing concrete _aisthesis_ in order to indicate the general. The process is not one of finding some general schema in the natural object and, by abstraction of the schema from the natural object, presenting it in isolation. This is not what we do when we make our straight line more visible. The _object_ for the mind was already, in that case, the straight line (since this was the intention by which it was drawn and seen). The process of 'abstraction' that our progression of drawings followed was not a removal of a schema from the object, but the removal of the object from superfluous perceptual clutter; we simply cut away the undetermined. We shall find a similar uncluttering going on in Brancusi's sculptural development of his theme.

Brancusi was fond of highly polished surfaces with little or no interruption in their smoothness. In this manner he sacrificed perceptual detail, but gained a sense of flow for the surface. He did the same things with his photographs of his sculpture, taking them all in very soft focus, sometimes to the extreme that detail which he had included in his sculpture was no longer visible. We may conclude that his directions for _seeing_ his sculptures are indicated by this. If this photography forces one to forget about even that detail which he may still find in the piece of metal or marble before him, it seems obvious that Brancusi has thereby fostered an intentional stance upon the viewer which focuses not on details but on whole surfaces, and therefore on _gesture_. Compare, for example, Plates XXIV and XXV, which present, respectively, Brancusi's photograph of a marble Bird in Space, and another man's viewing of a bronze Bird. The second Plate does allow us to pay some attention to the surface of the metal as a static texture. This is impossible in the case of the artist's photograph, which shows a shape reminiscent of a welder's flame, flowing from bottom to top and even accelerating through a seeming venturi just above the base. The gesture of the whole is more visible, because more isolated, in the blurred photograph than in the crisp one. Even so, the gesture of the Newborn (which is seen in a soft focus photograph on Plate XXI), is clearer than that of the First Cry.

The Newborn is more difficult to recognize because it is so far removed from ordinary appearances. But that does not mean that it is a more obscure image. The very opposite is the case. The First Cry could be, but for the title, the first breath, or the first stuffed nose, or the first yawn. The particular gesture made by the face is not all that clear. This is due to the fact that the perceptual details of the mouth, being too close to habitual appearances, are too indeterminant; they can be taken in multiple ways. The resultant structure resembles, not a particular expression, but an open mouth. A physical reality rather than a gesture. To cure this fault in the execution, Brancusi abandons the representation of physical, and therefore static, structure, and attempts to show gesture only. Thus the whole head is in motion, or at least in tension. It is dynamic rather than static. The title, and the context of earlier work, give the mode of viewing, without which we should be at a loss. But once we see the First Cry, or even understand that the Newborn is a newborn child, it is possible to see the sculpture without excessive difficulty.

There are a number of ways to view the First Cry until we know the title, which gives a focus. But the Newborn need not have Cry in the title, for if we are able to represent a child's head through it at all, the tremendous tension of the gesture we must then also represent leaves no doubt as to the activity. No mere breathing, or even yawning, could cause that. The piece is therefore a notable improvement in portrayal over the First Cry, for it is able to provide, by execution, a more determined aisthesis of the subject matter. (According to Goethe and Schiller, this means that the distance between the subject and its execution has decreased, and therefore the Newborn should be more beautiful than the First Cry. I leave the reader to decide in what ways this may, or may not, be true.)

We have seen, therefore, that the themes Goethe deals with, the distance between subject matter and execution, the artist's role in decreasing that distance, the specifications and therefore concrete visibility brought about by: idealization, begin to emerge as actual structural 'facts' when morphologically investigated. But such an investigation must be taken a great deal further if its potential is to be realized. It is but the potential that I have attempted to establish here.

(c) Morphology and the different disciplines

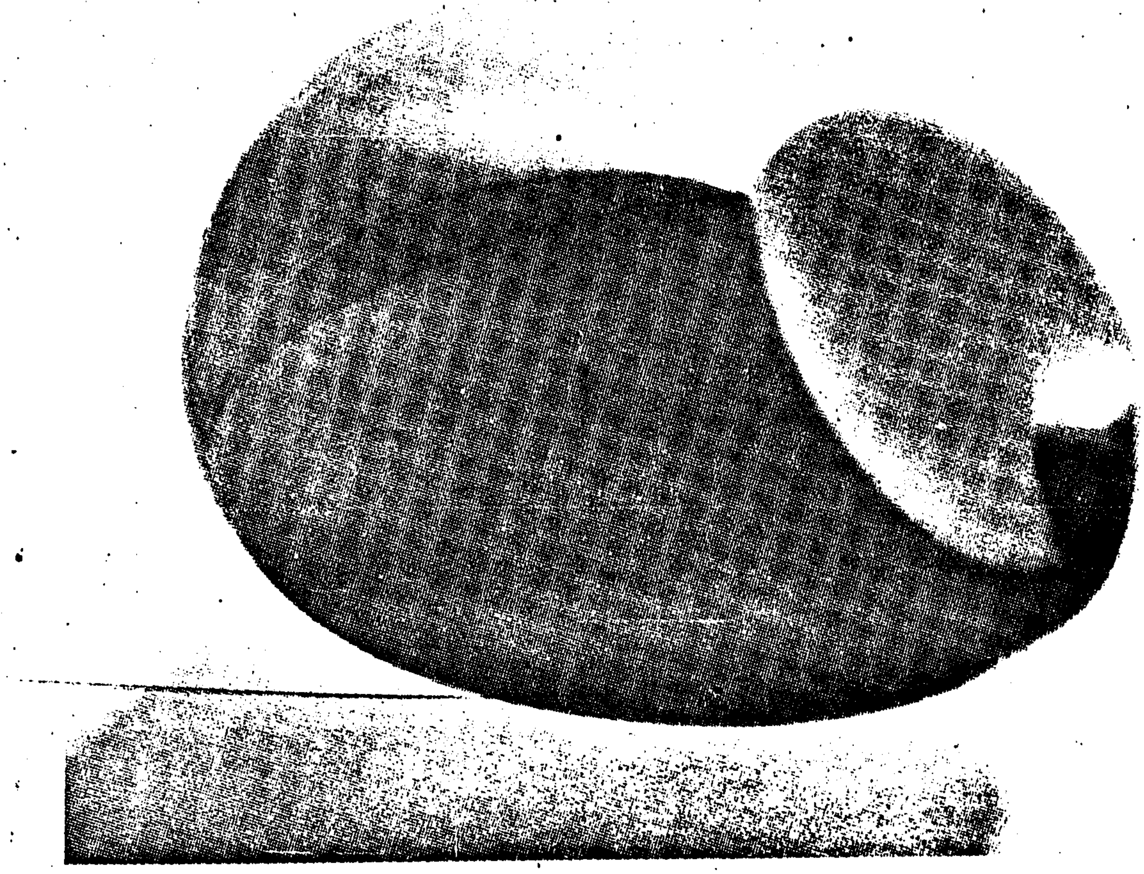
Morphology, as Goethe developed it, is the study of the structure of appearances through direct inspection of phenomenal appearances. It is, therefore, an independent science in itself, somewhat distantly related to geometry. Its results are of immediate interest, however, to a number of disciplines, and to Aesthetics in particular, since it takes a special interest in appearances. It provides Aesthetics, which has long been considered a fairly speculative pursuit, with an empiricism as rigorous as could be desired in any science. This may not exhaust the intentions of Aesthetics, but it most certainly does fit them very well.

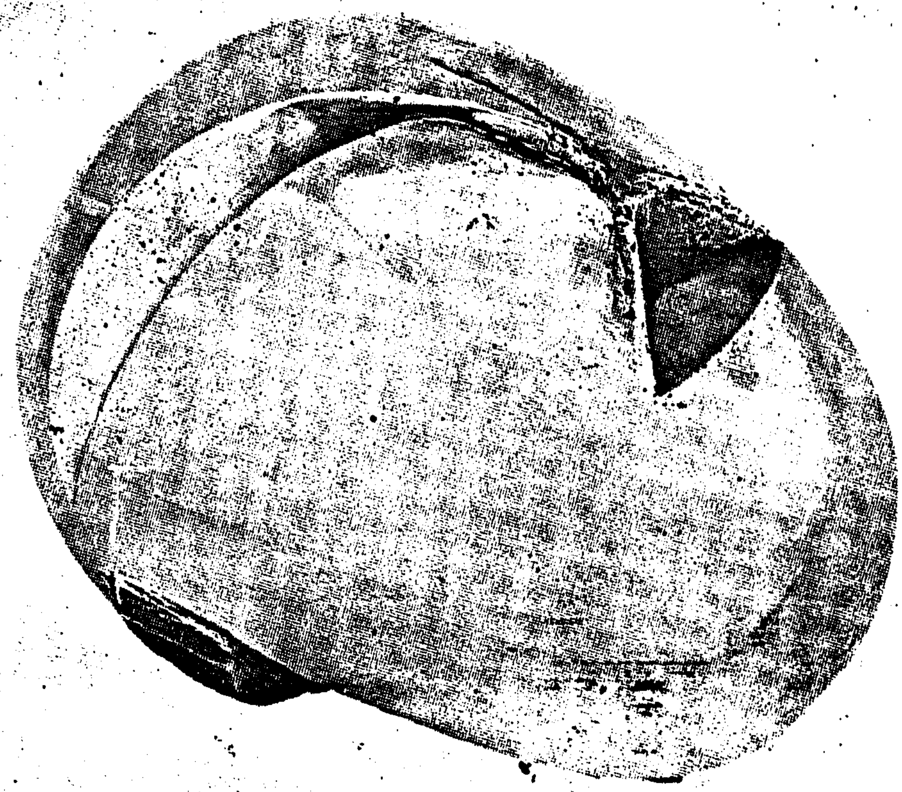
The structure of appearances however, is of direct interest to any empiricism. It is not therefore surprising to find that Goethe developed his morphology, not merely to study art, but to study Biology. Because the method of approach was somewhat systematically worked out with reference to this latter field, I was forced to take my examples from there. But this brought with it the intellectual responsibility of an estimation of the validity of Goethe's scientific method. I could do nothing else but welcome such a task, for in attempting to discover the empirical foundations implied by Schiller's theoretical position, I had already commited myself to an epistemological examination of the offered 'empiric evidence.' Such evidence could have no value if it was not scientifically determined—if not a product of an empirical science. Since the examples I chose were botanical ones, I would have to determine the scientific validity of conclusions which concerned, not merely appearances, but biological appearances. The justification of scientific method would therefore have to be a justification of biological method as well. But once the approach is justified as a method, the same considerations may be generalized for its application in other areas, namely in Aesthetics.

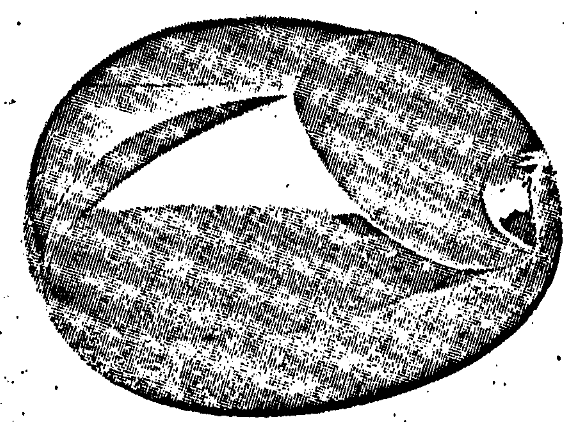
I have come to believe, through this labor, that the split between disciplines is a very artificial one, and sometimes detrimental to the progress of investigation. This entire discussion has been performed in pursuit of an inquiry in the province of Aesthetics, but it crossed the lines of disciplines. In order to do this successfully, it was necessary to point out the limitations of my investigation. I was following a study of apparent structure only—no question beyond this was under consideration. But with this qualification I see no reason why the biological inquiries made above are not equally aesthetic ones, not merely because two lines of inquiry cross at this point, but because they are essentially the same at this point. I was not asking, as I performed my aesthetic investigation of biological structure, two questions, but only one.

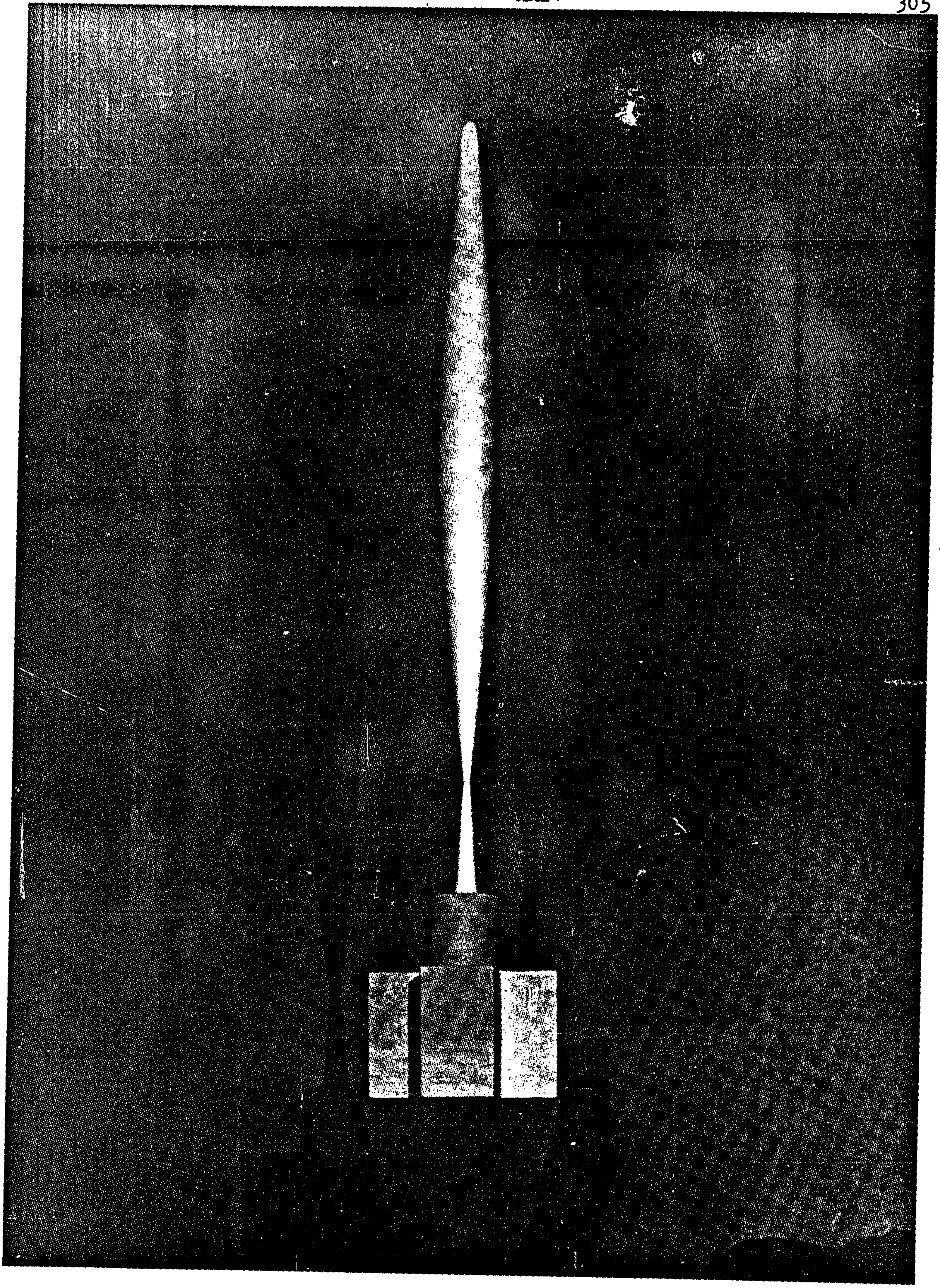
I believe that the disciplines are still divided, even at this late date, by a Linnaean mode of classification. Yet certainly this is not the impression one gets of provinces when he actually follows an idea. From that view, there are no compartments, particularly not watertight ones. We view instead a system of affinities and disaffinities, woven as warp and woof, in which the artificial distinctions of disciplines now practiced tears rents in order to fix boundaries and enforce discontinuities where there are none in nature. And all of us sit as the legislators of this situation.

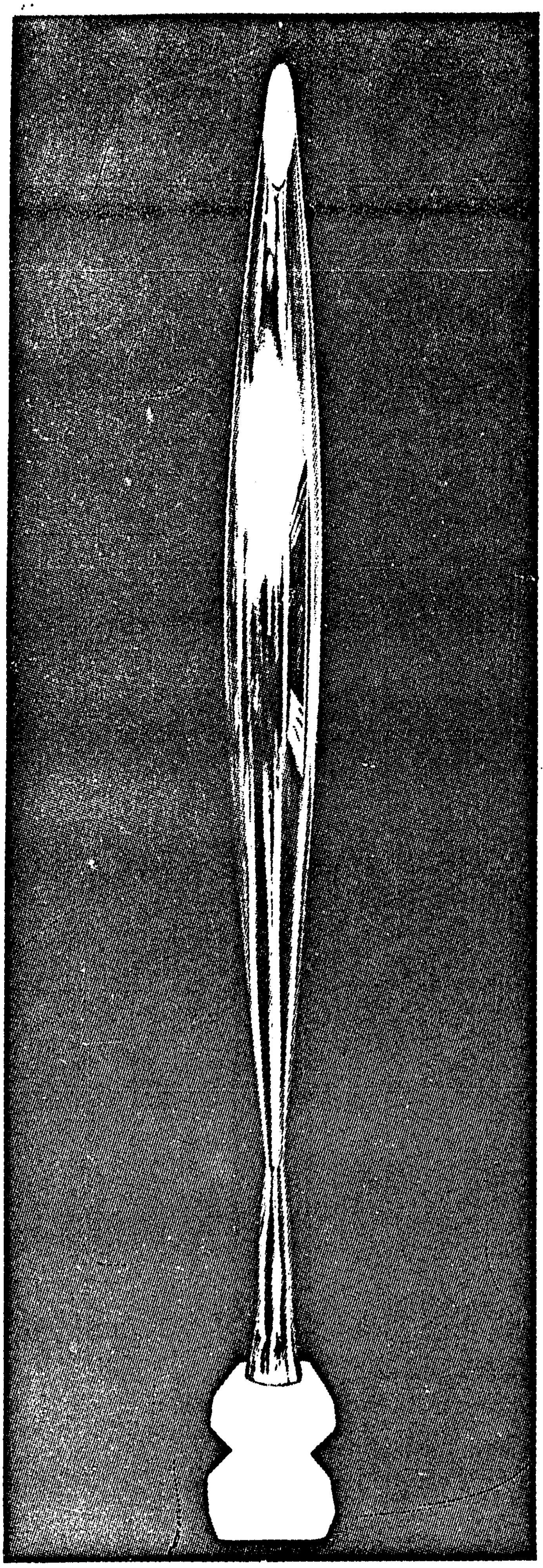
The Linnaean mode of classification was overcome by Cuvier's introduction of the natural type, based upon common plan. As we saw above, that common plan was a law in the phenomena, and therefore an idea for the mind. The modern natural system is a working out of the structure determined by this idea. The same solution may have to be worked out in the classification of disciplines. I have myself followed the explication of a single idea, throughout this paper, and yet found myself forced to cut across boundaries. But there were no boundaries there.

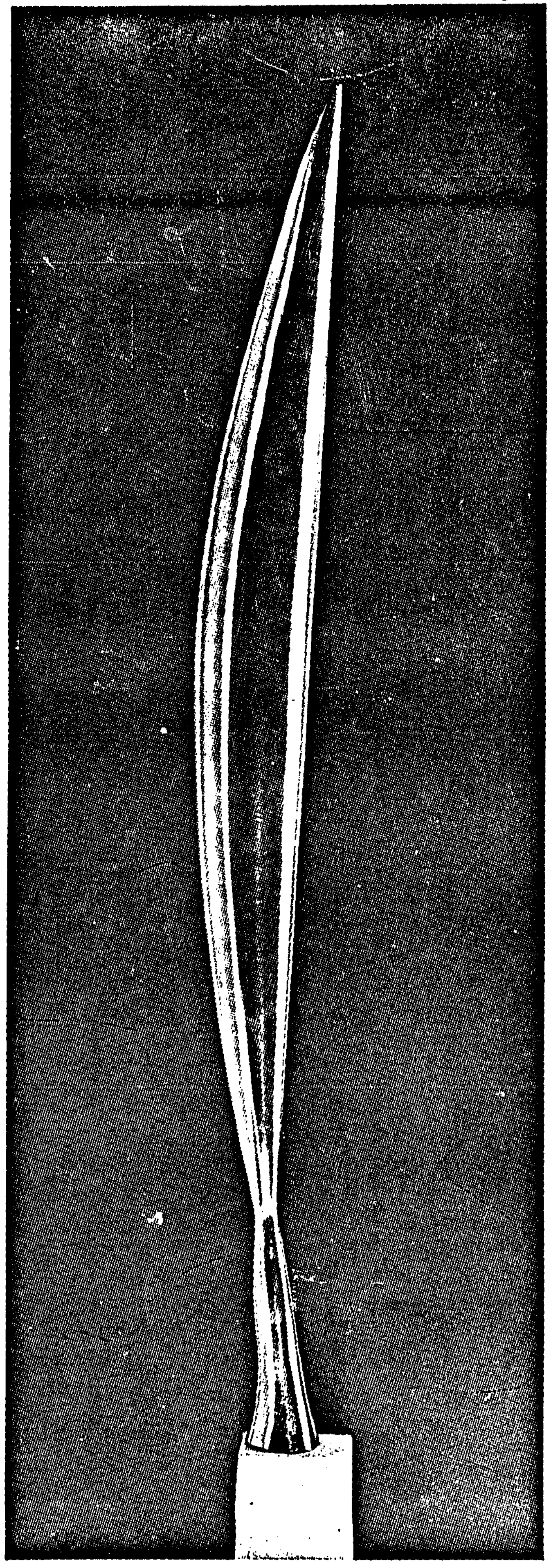












NOTES

Part I

I Kant

1 Critique of Judgment (New York, 1966) Trans. by J. H. Bernard; p. 171

2 Biographia Literaria (London, 1962) p. 169

3 Critique of Judgment, pp. 158-160.

4 Ibid., p. 161

5 Ibid. pp. 255-257

6 The Problem of Knowledge (London, 1950) See the discussion of this point in part II, section VI.

7 Ibid. Section VI

II Schiller

1 On the Aesthetic Education of Man (oxford, 1967) Trans. by E. M. Wilkinson and L. A. Willoughby; Letter I; p. 5.

2 Quoted in B. Bosanquet, A History of Aesthetic (London, 1966) p. 286

3 Correspondence of Schiller with Körner (london, 1849) Trans. by L. Simpson; letter of December 21, 1792

4 Sämtlich Werke, Band 17, (München, 1966) January 25, 1793; p. 162; translation mine.

5 Ibid. January 25, 1793, p. 162; translation mine.

6 Ibid. February 8, 1793; p. 167; translation mine.

7 Ibid. February 18, 1793; p. 167, translation mine.

8 Ibid., February 18, 1793; p. 168; translation mine.

9 *Ibid.* February 18, 1793; pp. 168-169; translation mine.

10 *Ibid.* February 23, 1793; p. 175; translation mine.

11 *Ibid.* February 23, 1793; p. 176; translation mine.

12 *Ibid.* February 23, 1793; p. 176; translation mine.

13 *Ibid.*, February 23, 1793; p. 176; translation mine.

14 *Ibid.*, February 18, 1793; p. 169; translation mine.

15 *Ibid.* February 18, 1793; p. 169; translation mine.

16 *Ibid.* February 23, 1793; p. 181; translation mine.

17 *Ibid.* February 23, 1793; pp. 181-182; translation mine.

III Schiller and Goethe

1 See his letter to Körner, 18, V, 1794.

2 See, for example, the extreme case made by S. S. Kerry in "The Artist's Intuition in Schiller's Aesthetic Philosophy" *Publications of the English Goethe Society* 1958-59, or the general summary of recent criticism made by T. M. Ellis, *Schiller's Kalliasbriefe and the Study of Aesthetic Theory* (The Hague, 1969) who concludes that although Kerry's position emphasizes irrational processes to the detriment of a true reading of Schiller's logic, one may agree with him at least as to the source of Schiller's insight, namely, his experience as a poet.

3 "Propitious Encounter," translated by B. Mueller in *Goethe's Botanical Writings* (Honolulu, 1952) p. 217

4 *Correspondence Between Schiller and Goethe* (London, 1877) translated by L. D. Schmitz; August 23, 1794

5 *Ibid.* August 31, 1794

6 Actually two critics—the quote is from the introduction of the Wilkinson and Willoughby edition of Schiller's *On the Aesthetic Education of Man*, evidently a joint production of both editors. p. xxxviii

7 *On the Aesthetic Education of Man*, p. 89, Letter XIII

8 *Correspondence Between Schiller and Goethe*, January 19, 1798

9 "Considerable Assistance from One Ingeniously Chosen Word," in Goethe's Botanical Writings; p. 235

10 Ibid. p. 237

11 "Betrachtung über Morphologie überhaupt," Sämtliche Werke, Band 39 (München, 1963) p. 91; translation mine.

12 The Natural Philosophy of Plant Form (Cambridge, 1950) p. 209

13 "Die Absicht eingeleitet," Sämtliche Werke, Band 39, pp.8-9; translation mine.

14 Goethe's Theory of Colours (London, 1840) Translation by C. L. Eastlake; p. xvii

15 Goethe im Gespräch (Leipzig, 1907) p. 252; translation mine.

16 "Intuitive Judgment" in Goethe's Botanical Writings, pp. 232-233

17 Letter to Jacobi, June 29, 1795, translated by Wilkinson and Willoughby in their introduction to On the Aesthetic Education of Man, p. lxxviii

18 Quoted from the same source, p. xli; translation mine.

Iv Goethe

1 "Maximen und Reflexionen," Goethes Werke, Band XII (Hamburg, 1967) #719; translation mine.

2 Ibid. #746

3 Ibid. #747

4 From Eckermann, April 18, 1827; as translated in Goethe, Wisdom and Experience (New York, 1949) p. 228

5 From The Autobriography III,11, 1814, 24, 49-50; as translated in Goethe, Wisdom and Experience, p. 224

6 The following translations are taken from the Italian Journey (New York, 1968) Translated by W. H. Auden and E. Mayer.

7 From Eckermann, September 1, 1829; as translated in Goethe, Wisdom and Experience, p. 145

8 *Hegel's Philosophy of Nature* (Oxford, 1970) Translated by A. V. Miller; p. 311 (This is the second section of the *Encyclopaedia.*)

9 *Ibid.* p. 315

10 *The Problem of Knowledge*, p. 137

Part II

I Metamorphosis

1 "The Author Relates the History of his Botanical Studies," *Goethe's Botanical Writings*, p. 159

2 *Ibid.* p. 160

3 *Ibid.* p. 160

4 *Hard Times* (New York, 1961) pp. 13-14

5 "Genesis of the Essay on the Metamorphosis of Plants," *Goethe's Botanical Writings*, p. 166

6 Steiner, Rudolf *Goethe the Scientist* (New York, 1950) p. 74 The younger man is identified only as "Vogt."

7 "Die Absicht eingeleitet," *Sämtliche Werke*, Band 39, pp.8-9; translation mine.

8 All quotations from the *Metamorphosis of Plants* will be taken from Agnes Arber's translation in *Chronica Botanica*, Vol. X (Cambridge, 1946) pp. 67-114

II Historical Interpretations

1 Von Jaeger's remarks were originally made in his *Ueber die Missbildungen der Gewächse* (Stuttgart, 1814) which text I could not find. His position is reviewed by Agnes Arber in her introduction to her translation of *The Metamorphosis of Plants*; *Chronica Botanica*.

2 My remarks on the work of Linnaeus and other figures in this chapter are based mostly upon Erik Nordenskiöld, _The History of Biology_ (New York, 1928); Charles Singer, _A History of Biology_ (New York, 1959); Emanuel Rádl, _The History of Biological Theories_ (London, 1930); and F. S. Bodenheimer, _The History of Biology, An Introduction_ (London, 1958). In order to understand the crucial transition from idealistic to phylogenetic morphology, however, it was necessary to read works of Owen, Huxley, Darwin, and a number of contemporaries. A very detailed history of Goethe's relations with biologists of his time may be found in Steiner, _Goethe The Scientist_.

3 _Philosophy of Nature_ (Oxford, 1970) p. 315

4 Bodenheimer, _op. cit._, p. 356

5 Cassirer, Ernst _The Problem of Knowledge_ (New Haven, 1950) pp. 130-131

6 Nordenskiöld, _op. cit._, p. 342 Translation mine.

7 _Ibid._ p. 342

8 _Report on the Archetype and Homologies of the Vertebrate Skeleton_ (London, 1846) p. 175

9 _Ibid._ p. 175

10 _The Scientific Memoirs of T. H. Huxley_ Vol. I. (London, 1898) p. 539

11 _Ibid._ p. 571

12 _Ibid._ p. 571

13 _Ibid._ pp. 584-585

14 _Ibid._ p. 282

15 _Ibid._ p. 283

16 _Ibid._ p. 541

17 _Ibid._ p. 585

18 _Evolution, The Modern Synthesis_ (New York, 1950) pp. 390-391

19 _The Origin of Species, A Variorum Text_ (Philadelphia, 1959) Passage from First edition: p. 476

20 _Ibid._ Passage from first edition: pp. 676-677

21 *Ibid.* Passage from the first edition: p. 678

22 *Ibid.* Passage from the first edition: p. 683

23 *The Scientific Memoirs of T.H. Huxley* Vol. IV (London, 1902) p. 186

24 Rådl, *op. cit.*, pp. 131-132

25 *Idealistische Morphologie und Phylogenetik: Zue Methodik der Systematischen Morphologie* (Zurich, 1919) p. 33 Translation mine.

26 *Ibid.* p. 69

27 Cassirer, *op. cit.*, p. 145, note.

28 *The Natural Philosophy of Plant Form* (Cambridge, 1950) pp. 63-64

29 *The Scientific Memoirs of T.H. Huxley* Vol. IV (London, 1902) p. 671

III The Problem of Type

1 *The Scientific Memoirs of T.H. Huxley*, Vol. I, p. 539

2 Arber, *The Natural Philosophy of Plant Form*, p. 63

3 As diagrammed in his *Report*, p. 249

4 *Studies in Words* (Cambridge, 1961) p. 14

5 *Ibid.* pp. 15-16

6 *History in English Words* (London, 1962) p. 143

7 *Ibid.* p. 143

8 "Entdeckung eines trefflichen Vorarbeiters; Wenige Bemerkungen," *Sämtliche Werke*, Band 39, p. 80; translation mine.

9 With the development of phenomenological approaches in German philosophy the 'innocent eye' became an obsolete notion. So much work has been done on this point that a bibliography of the subject would be unwieldy because of its size. The reader may find rather clear treatments of the subject in Ernest Gombrich's Art and Illusion (New York, 1960) or Owen Barfield's Saving the Appearances (New York, 1957).

10 Quoted from the Introduction to her translation of the Metamorphosis of Plants; Chronica Botanica Vol. X, p. 74

11 On Growth and Form (Cambridge, 1968) pp. 1048-1049

12 The Material Basis of Evolution (Patterson, New Jersey, 1960) pp. 311-323

13 Italian Journey, April 17, 1787

IV The Dialectic of Experience

1 Reid, Thomas Philosophical Works (Hildesheim, Germany, 1967) The passage is from An Inquiry into the Human Mind on the Principles of Common Sense; p. 163

2 See Kemp Smith's translation of the Critique of Pure Reason (London, 1929) Text A 189-95; Text B 233-240

3 Vorträge und Reden (Braunschweig, Germany, 1896) p. 36 Translation mine.

4 Arber, The Natural Philosophy of Plant Form p. 67

5 Poetic Diction (London, 1962) p. 190

6 Ibid. p. 191

7 A critical study of the position behind this famous phrase of Shelley's Defence of Poetry may be found in John Wright's Shelley's Myth of Metaphor (Athens, Georgia, 1970)

8 Bowie, Henry P. On The Laws of Japanese Painting (New York, 1960) pp. 78-79

9 Time (New York) July 14, 1952

10 "Betrachtung über Morphologie überhaupt," Sämtliche Werke, Band 39, p. 91

11 *Time*, July 14, 1952

12 *Goethe's Theory of Colours* (London, 1840) pp. xx-xxi

13 From the *Maxims and Reflections* as translated in *Goethe, Wisdom and Experience*, p. 120

14 *Ibid.* p. 123

15 *Ibid.* p. 123

16 "Experience and Science," *Goethe's Botanical Writings* p. 227

17 *Ibid.* p. 228

18 *Ibid.* p. 227

19 *Goethe's Theory of Colours*, p. xvii

20 "Increasing Difficulty in Botanical Instruction" *Goethe's Botanical Writings* p. 115

V Morphology and Aesthetics

1 *Sämtliche Werke*, Band 17, p. 167 Translation mine.

2 *Ibid.* p. 167 Translation mine.

3 *Ibid.* p. 176 Translation mine.

4 *Ibid.* p. 169 Translation mine.

5 *Ibid.* p. 169 Translation mine.

6 *Ibid.* p. 169 Translation mine.

7 Ibid. p. 181 Translation mine.

8 *Ibid.* p. 181 Translation mine.

9 "Maximen und Reflexionen," *Goethe's Werke*, Band XII #719; translation mine.

10 From Eckermann, April 18, 1827; as translated in *Goethe, Wisdom and Experience*, p. 228

11 "Maximen und Reflexionen," Goethes Werke, Band XII, #747; translation mine.

12 From *Propylaen*, as translated in *Goethe, Wisdom and Experience*, pp. 227-228

13 Eckermann, *Conversations with Goethe* (New York, 1951) pp. 273-274

14 From *Maxims and Reflections*, as translated in *Goethe, Wisdom and Experience*, p. 228

15 From a letter to Zelter, October 30, 1808, as translated in *Goethe, Wisdom and Experience*, p. 224

16 *Goethe's World View* (New York, 1963) p. 153

17 From Eckermann, February 4, 1829, as translated in *Goethe, Wisdom and Experience*, p. 226

18 From the *Autobiography*, as translated in *Goethe, Wisdom and Experience*, p. 224

19 *Constantin Brancusi 1876-1957; A Retrospective Exhibition* (New York, 1969) p. 71

Sources of Illustrations

Plates II, XI, XV Fig. 2: J. Bockemühl; <u>Elemente der Naturwissenschaft</u> Dornach, Schweiz.

Plates IV, V, IX, X, XII, XIII, XIV: <u>Goethe's Botanical Writings</u> (Honolulu, 1952)

Plates XVII, XVIII, XIX: D'Arcy Thompson, <u>On Growth and Form</u> (Cambridge, 1968)

Plate XXI: Theodor Schwenk, <u>Sensitive Chaos</u> (London, 1965)

Bibliography

Primary Bibliography

GOETHE, JOHANN WOLFGANG

SW = Sämtliche Werke (München, Deutscher Taschenbuch Verlag, 1963)

Chronik von Goethes Leben. Bibliographie. Register SW, Bd. 45

Dichtung und Wahrheit, SW, Bds. 22-23-24

Zue Farbenlehre, Didaktische Teil, SW, Bd. 40

Goethe im Gespräch (Leipzig, 1906)

Geschichte der Farbenlehre, SW, Bds. 41-42

Italienische Reise, SW, Bds. 25-26

Maximen und Reflexionen, SW, Bd. 21

Schriften zur Anatomie, Zoologie, und Physiognomik, SW, Bd. 37

Schriften zur Botanik und zur Wissenschaftslehre, SW, Bd. 39

Schriften zur Geologie, Mineralogie, und Meteorologie, SW, Bd.38

Schriften zur Kunst, SW, Bds. 33-34

Schriften zur Literatur, SW, Bds. 31-32

Translation

Goethe's Botanical Writings Trans. B. Mueller (Honolulu, 1952)

Goethe's Theory of Colours Trans. C.H. Eastlake (London, 1840)

Italian Journey Trans. W.H. Auden and E. Mayer (New York, 1968)

SCHILLER, FRIEDRICH

SW = Sämtliche Werke (Munchen, Deutscher Taschenbuch Verlag, 1966)

Theoretische Schriften I, II, III, IV, SW, Bds. 17-18-19-20

Translation

Letters on the Aesthetic Education of Man Trans. by E. M. Wilkinson and L.A. Willoughby (Oxford, 1967)

Naive and Sentimental Poetry; On the Sublime (New York, 1966)

Other primary sources

Briefwechsel zwischen Schiller und Goethe Herausgegeben von Emil Staiger (Frankfurt, 1966)

Eckermann, J.P. Gespräche mit Goethe (Wiesbaden, 1959)

Secondary Bibliography

GOETHE

Arbor, Agnes. "Goethe's Botany" Chronica Botanica X, 2 (1946)

______, The Natural Philosophy of Plant Form (Cambridge, 1950)

Cassirer, Ernst. Freiheit und Form (Berlin, 1922)

______, "Goethe und die mathematische Physik." Idee und Gestalt (Berlin, 1924)

______, The Problem of Knowledge, Philosophy, Science, and History since Hegel, (New Haven, 1950)

Croce, Benedetto. Goethe (New York, 1923)

Gillispie, Charles C. The Edge of Objectivity: An Essay in the History of Scientific Ideas (Princeton, 1960)

Gray, Ronald. Goethe the Alchemist (Cambridge, 1962)

Hansen, A. Goethes Metamorphose der Pflanzen (Giessen, 1907)

______, Goethes Morphologie (Giessen, 1919)

Hayata, Bunzō. "An Interpretation of Goethe's Blatt in his Metamorphose der Pflanzen as an Explanation of the Principle of Natural Classification" Icones Plantarum, X (Formosa, 1931)

Hegel, G.W.F. Philosophy of Nature (Part two of the Encyclopaedia of the Philosophical Sciences) Trans. A.V. Miller (London, 1970)

Heisenberg, Warner. "Das Naturbild Goethes und die technisch-natu r wissenschaftliche Welt" Jahrbuch der Goethe-Gesellshaft, XXI, (1967)

______, "Die Goethische und Newtonische Farbenlehre im Lichte der Modernen Physik" Geist der Zeit, XIX: 5 (May, 1941)

______, Wandlungen in den Grundlagen der Naturwissenschaft (Munich, 1947)

Heller, Erich. Goethe and the Idea of Scientific Truth (Oxford, 1949)

Helmholz, Hermann. "Ueber Goethes Naturwissenschaftliche Arbeiten" Vorträge und Reden (Braunschweig, 1896)

Henel, Heinrich. "Type and Proto-Phenomenon in Goethe's Science" PMLA (1956)

Jockers, Ernst. "Morphologie und Klassik Goethes" Goethe und die Wissenschaft (Frankfurt, 1951)

Lehrs, Ernst. Man or Matter (London, 1958)

Magnus, Rudolf. Goethe as a Scientist (New York, 1961)

Menzer, Paul. "Goethes Ästhetik," Kantstudien, 72 (1957)

Müller, Gunther. "Die Gestaltfrage in der Literaturwissenschaft und Goethes Morphologie," Die Gestalt 13 (Halle, 1964)

Oppel, Horst. Morphologische Naturwissenschaft. Goethes Ansicht und Methode (Mainz, 1947)

Overbeck, Gertrude. "Goethes Lehre von der Metsmorphose der Pflanzen und ihre Widerspiegelung in seiner Dichtung," Publications of the English Goethe Society, new series, XXXI (1960-61)

Salm, Peter. The Poem as Plant (Cleveland and London, 1971)

Santayana, George. Three Philosophical Poets (Cambridge, 1947)

Sewel, Elizabeth. The Orphic Voice (Cambridge, 1960)

Sherrington, Charles. Goethe on Nature and Science (Cambridge, 1949)

Steiner, Rudolf. "Goethe als Vater einer neuen Ästhetik," Methodische Grundlagen der Anthroposophie (Dornach, Schweiz, 1961)

______, Goethe the Scientist, Trans. C.D. Wannamaker (New York, 1950)

______, Goethes Waltanschauung (Dornach, Schweiz, 1963)

______, The Theory of Knowledge Implicit in Goethe's World-Conception Trans. C.D. Wannamaker (New York, 1940)

Trevelyan, H. Goethe and the Greeks (Cambridge, 1949)

Troll, Wilhelm. Goethes Morphologische Schriften (Jena, 1926)

Viëtor, Karl. Goethe the Poet, Trans. Moses Hadas (Cambridge, Mass. 1949)

______, Goethe the Thinker, Trans. B.Q. Morgan (Cambridge, Mass, 1950)

Wachsmuth, Andreas B. "Goethes Farbenlehre und ihre Bedeutung fün seine Dichtung und Weltanschauung," Jahrbuch der Goethe-Gesellschaft XXI (1959)

Wilkinson, E.M. and Willoughby, L.A. Goethe, Poet and Thinker (London, 1962)

SCHILLER

Bohning, E.E. "Goethe's and Schiller's Interpretation of Beauty" GQ XXII (1949)

Cassirer, Ernst. Freiheit und Form (Berlin, 1922)

______, "Die Methodik des Idealismus in Schiller's philosophischen Schriften," Idee und Gestalt (Berlin., 1921)

Ellis, T.M. Schiller's Kalliasbriefe and the Study of Aesthetic Theory, (The Hague, 1969)

Kerry, S.S. Schiller's Writings on Aesthetics (Manchester, 1961)

Wilkinson, E.M. "Schiller's concept of Schein in the light of recent Aesthetics" GQ XXVIII (1955)

Zimmermann, R.L. Kant, Schiller, and Hegel: A study in metaphysical aesthetics (New York, 1962)

Biological

Aggassiz, Louis. Essay on Classification (Cambridge, Mass. 1962)

Arbor, Agnes, The Mind and the Eye (Cambridge, 1953)

Darwin, Charles. The Origin of Species, Variorum Text. (Philadelphia, 1959)

Huxley, Julian. Evolution, The Modern Synthesis (New York, 1943)

Huxley, Thomas H. The Scientific Memoirs of T.H. Huxley (London, 1898-1902)

Meyer, Adolf. Ideen und Ideale der Biologische Erkenntnis (Leipzig, 1934)

Naef, Adolf. Idealistische Morphologie und Phylogenetik (Jena, 1919)

Nordenskiöld, E. The History of Biology, Trans. I.B. Eyre (London, 1929)

Oken, Lorenz. Physiophilosophy (London, 1847)

Owen, Sir Richard. On the Archetype and Homologies of the Vertebrate Skeleton (London, 1848)

Rådl, Emmanuel. The History of Biological Theories (London, 1930)

Singer, Charles. A Short History of Biology (Oxford, 1931)

Sinnot, E.W. The Problem of Organic Form (New Haven, 1963)

Thompson, D'Arcy Wentworth. On Growth and Form (Cambridge, 1963)

Troll, Wilhelm. Praktische Einfuhrung in die Pflanzenmorphologie (Jena, 1954)

Philosophic

Bosanquet, Bernard. A History of Aesthetic (London, 1892)

Cassirer, H.W. A Commentary on Kant's Critique of Judgment (London, 1938)

Hegel, G.W.F. _Philosophy of Fine Art_, Trans. F.P.B. Osmaston (London, 1920)

Kant, Emmanuel. _Critique of Judgment_, Trans. J.H. Bernard (London, 1966)

_____, _Critique of Pure Reason_, Trans. N. Kemp Smith (London, 1963)

_____, _Observations of the Feeling of the Beautiful and the Sublime_, Trans. J.T. Goldthwait (Berkeley, 1965)

Kröner, Richard. _Von Kant bis Hegel_, (Tubingen, 1921,1924)