

## IV

### GOETHE AND SCIENCE

**P**ROBABLY most people if asked to name the antithesis of poetry would unthinkingly say prose, but a moment's thought would convince them that they would have to seek further for a real antithesis. They would probably, in the end, come to agree with Wordsworth that the antithesis of poetry is science. Poetry lies in the realm of the spiritual; it is a product of the mind, expressed in artistic form; it represents experiences and ideas, and appeals to the emotions. Science is the food of the mind, and represents observations and facts, without relation to their emotional bearing. Science is the soil in which the mind is rooted and from which it sucks its nourishment; poetry is the nectar secreted by the flower. Perhaps we might go further and make use of Goethe's own theory of the metamorphosis of plants. According to this theory every plant consists of a succession of parts, each fundamentally the same but profoundly modified for different functions—leaves, sepals, petals, stamens—all modifications of a single type organ. If we liken the human mind, in the aggregate, to a plant, each individual mind may be likened to one of its organs. The more highly modified is the organ for a typical function, the less likely is it to be able to perform other functions. Therefore a mind which is adapted to the secretion of nectar would not be expected to be able to function as a root, capable of absorbing and assimilating scientific nourishment. And in truth it is rare indeed that it can do so. Goethe himself, if he is an exception, is one of the few our race has yet produced.

The very fact that Goethe was a great poet, and very generally recognized as such, proved a real stumbling block to his recognition as a scientist. His scientific efforts have been looked upon as the dabbling of an amateur, or as the attempt of a mind great in one field, and failing to understand its own limitations, to expand and look for prestige in a field to which it must inevitably be poorly adapted. Goethe himself felt that there was some justification for the public which acclaimed him as a poet being hesitant about praising him as a scientist, but added that an energetic mind feels itself brought into the world for its own development and not for the approbation of the public; it declines to fatigue and exhaust itself by always doing the same thing, and seeks relaxation elsewhere. But for Goethe science was not only a relaxation or a distraction; it was a serious work in which his interest was very great throughout his life. Two years before his death, when in his eighty-first year, an incident occurred which illustrates the profound interest which this remarkable man took in scientific matters. News of the Revolution in France of July 1830 had just reached Weimar and aroused very great commotion. When his friend Eckermann called on him that day Goethe greeted him with the words: "Now what do you think of this great event. The volcano has come to an eruption; everything is in flames and we have no longer a transaction behind closed doors." Eckermann naturally supposed his friend was referring to the revolution, but instead he was referring to a famous intellectual duel between Cuvier and Geoffrey St. Hilaire in the French Academy of Sciences on the question of descent of animals and plants. In spite of the fact that political questions had always been of interest to him, and he himself had been in politics to some extent a large part of his life, his interest in a public debate on a scientific

question transcended his interest in a great political climax. Goethe regarded Geoffrey St. Hilaire as a champion, in France, of views and ideas which he himself had held for a long time but which as yet had not been generally accepted. To use Goethe's words to Eckermann, "I have exerted myself in this affair for fifty years. At first I was alone, then I found support, and now at last to my great joy, I am surpassed by congenial minds. . . . This occurrence [the debate referred to] is of incredible value to me; and I justly rejoice that I have at last witnessed the universal victory of a subject to which I have devoted my life, and which, moreover, is my own, *par excellence*." It is of interest to note, in passing, that Goethe was undisturbed by the fact that St. Hilaire was defeated in the debate by Cuvier; the mere fact that the discussion had come out into the open and was considered of sufficient importance for a public debate in the Academy was enough to fill him with joy; Cuvier's temporary victory had no significance for him.

Goethe's interest in science must have developed at an early date. As a young student at Strasburg, where he was supposed to be studying jurisprudence, we find law, logic, Latin, and philosophy palling on him, while he took delight in attending lectures on chemistry, anatomy, and physics. Although he lived at a time when mathematics held a very high place in the esteem of the learned world, Goethe never had much use for this branch of science. His poetic mind was capable of interesting itself in the problems of biology and geology and even chemistry, but the fusion of poetry and mathematics could not be achieved even by Goethe. He went no further than the rudiments of arithmetic and geometry, and prided himself on not being a slave to a field of thought in which he said there was nothing exact but its own exactness, in which everything becomes clearer and at

the same time poorer, and in which everything drowns its own being and character. "I conceive mathematics," he says, "as the most sublime and useful science so long as they are applied in their proper place; but I cannot commend the misuse of them in matters which do not belong in their sphere, and in which, noble science as they are, they seem to be mere nonsense. As if, forsooth! things only exist when they can be mathematically demonstrated. It would be foolish for a man not to believe in his mistress's love because she could not prove it to him mathematically. She can mathematically prove her dowry, but not her love. The mathematicians did not find out the metamorphosis of plants. I have achieved this discovery without mathematics and the mathematicians were forced to put up with it." In his famous controversy over the Newtonian theory of colors Goethe was severely handicapped by his lack of mathematical knowledge, so he proceeded to ridicule Newton for having to resort to mathematics to explain such obvious things as colors. "To understand the phenomena of color," he says, "nothing is required but unbiassed observation and a sound head, but these are scarcer than folks imagine. . . . I have attempted natural science in nearly every department, but my tendencies have always been confined to such objects as lay terrestrially around me and could be immediately perceived by the senses. Therefore I have not occupied myself with astronomy, because here the senses are not sufficient and one must have recourse to instruments, calculations and mechanics which require a whole life, and are not in my line."

Goethe was not overstating the facts when he said he had attempted natural science in nearly every department. At the university, as already intimated, he attended lectures on various sciences; as a member of the court at Weimar

he travelled about the duchy, studying its physical geography, its fauna and flora; as a commissioner of mines he delved into geology and mineralogy, and became interested in the natural processes by which the physical features of the country had been molded; and he interested himself in comparative anatomy and morphology of animals and plants, although he had little patience with the form of botany then in vogue, that of dissecting plants to find their Latin names. Just as in geology he was more interested in how formations were produced by nature than he was in classification of minerals, so in botany the relations of parts of plants to one another and of different kinds of plants to one another were of more interest than their identification. Throughout his travels in Europe he was constantly observing, speculating, and making notes on all sorts of objects and incidents which he observed in nature, thus storing up a mass of material on which to draw. When he visited the botanical gardens in Palermo and saw a host of new and strange plants, he wondered if he could find the primordial plant which he could recognize as a fundamental type of which all others were modifications.

It was this penchant of Goethe's for observing things and then speculating and theorizing about them which led to the formulation of his many scientific ideas. Goethe himself recognized two types of scientists: those who laboriously devote themselves to the accumulation of facts, and those who, with the facts or without them, construct theories and attempt to unify and coördinate natural phenomena. In one case the theory follows the accumulation of facts and in the other the facts follow the formulation of the theory. Goethe was definitely of the latter type—he was an architect who drew the plans for a beautiful structure without regard to mechanical difficulties or to the availability of

materials. Having drawn his plans he sometimes descended to search for materials and work out the mechanical difficulties. If he succeeded all was well; if not, it was still a good plan. He was a man who viewed nature from a mountain peak and descended to the plains merely to verify the truth of his observations. The difference between the two methods of approach is very well expressed by Goethe himself in his comparison of Cuvier with St. Hilaire. "Cuvier," he says, "is never weary of observing and describing accurately what falls under his observation and thus extending his empire over a vast surface; Geoffrey St. Hilaire studies in silence the analogies of organized beings and their mysterious affinities. The former starts from individuals in order to arrive at a whole which is presupposed although considered unattainable; the latter carries within himself the image of the whole and lives in the persuasion that little by little the individual will be deduced from it. Cuvier, forever analyzing and distinguishing, always using observations as his starting point, does not believe in the possibility of an intuition, a prevision of a part in the whole. A desire to know and distinguish what cannot be seen by bodily eyes or touched by hands seems to him exorbitant. Geoffrey, resting on fixed principles, abandons himself to his lofty inspirations, and does not submit to the authority of this method. Analysis requires so much perspicacity, such sustained attention, such aptness at tracing variations of form in the smallest details and such talent for nomenclature in naming these differences, that one can scarcely blame the pride of a man gifted with all these faculties, if he looks upon this method as the sole true and rational one. How could he make up his mind to share a fame so painfully acquired by laborious effort with a rival who has had the art of reaching without difficulty a goal where the prize

should be given only to industry and perseverance? Assuredly, however, a man who starts from an idea has a right to feel proud of having conceived a leading principle. He will constantly repose on the certainty that isolated facts will verify what he has pointed out as a general fact." Even if the facts do not always fall in line with the theory, Goethe is not much disturbed. In discussing his theory of weather with Eckermann, he says that scientific men and especially the mathematicians would not fail to consider his ideas perfectly ridiculous, or else they would do better, they would totally ignore them in a most stately manner. "But do you know why? because they say I am not one of the craft. . . . But," he says, "the thing is very simple and I abide by what is simple and comprehensive, without being disturbed by occasional deviations. I merely observe that many collateral influences exist, the nature of which we do not yet understand." For a scientist this is a very comfortable attitude to take.

The fact that other scientists did not share Goethe's faith in his theories when the occasional deviations manifested themselves was a great thorn in his side, and in this respect he showed an almost puerile pride and egotism, and had a very pronounced martyr complex. He comments on the narrow-mindedness with which scientific men contend among themselves for priority. He accuses scientists of being bound down by tradition. Professors, he says, after finding a better theory, still talk of Newton's. "This is not to be wondered at; such people continue in error because they are indebted to it for their existence. Otherwise they would be put to the inconvenience of learning everything over again, and that would be very inconvenient. They do not prove the truth nor is such the intention; the only point with these professors is to prove their own opinion. On this

## 136            Goethe Centenary Lectures

account, they conceal all those experiments which would reveal the truth, and show their doctrine was untenable. . . . The phrases men are accustomed to repeat incessantly end by becoming convictions, and ossify the organs of intelligence. . . . If anyone advances anything now which contradicts, perhaps threatens to overturn, the creed which we have for years repeated, and have handed down to others, all passions are raised against him, and every effort is made to crush him. People resist with all their might; they act as if they neither heard nor could comprehend; they speak of the new view with contempt, as if it were not worth the trouble of even so much as an investigation or a regard, and thus a new truth may wait for a long time before it can make its way. A Frenchman said to a friend of mine concerning my theory of colors, 'We have worked for fifty years to establish and strengthen the kingdom of Newton and it will require fifty years more to overthrow it.' The body of mathematicians has endeavored to make my name so suspected in science that people are afraid of even mentioning it. . . . I am accustomed to it, and prepared for it. But say yourself, have I not sufficient reason to feel proud, when for twenty years I have been forced to own to myself that the great Newton, and mathematicians and august calculators with him, have fallen into a decided error with respect to the theory of colors; and that I, amongst millions, am the only one who knows the truth on this important subject? With this feeling of superiority, it was possible for me to bear with the stupid pretensions of my opponents. People endeavored to attack me and my theory in every way, and to render my ideas ridiculous; but, nevertheless, I rejoiced exceedingly over my completed work. All the attacks of my adversaries only serve to expose to me the weakness of mankind. . . . The errors of my opponents



have been too generally spread during a century for me to hope to find any companions on my solitary way. I shall remain alone! I often compare myself to a shipwrecked man, who has seized upon a plank which is only sufficient to bear one person. This one is saved, whilst all the rest are miserably drowned."

Goethe even goes so far as to take more pride in his scientific work than in his accomplishments as a poet. "As for what I have done as a poet," he would say repeatedly, "I take no pride in it whatever. Excellent poets have lived at the same time with myself, poets more excellent have lived before me, and others will come after me. But that in my century I am the only person who knows the truth in the difficult science of colors—of that, I say, I am not a little proud, and here I have a consciousness of superiority to many."

This very theory of colors, in which Goethe expresses such inordinate pride, is his one extremely weak point. His attitude towards it is somewhat like that of a mother towards a wayward child, and one cannot but believe that he himself had a sneaking suspicion that he was wrong, and that a sense of vulnerability was the cause of his intense feeling about the matter. Although his biological theories were also attacked or disregarded, he accepted opposition gracefully, but he fairly bristled with irony and anger even when his old friend Eckermann, in a spirit of earnestness and friendliness, pointed out to him certain facts he had observed which he could not harmonize with Goethe's theory. Helmholtz, to give some idea of the passionate way in which Goethe, usually so temperate and even courtier-like, attacks Newton, quotes from a few pages of the controversial part of his work the following expressions, which he applies to the propositions of this consummate thinker

## 138 Goethe Centenary Lectures

in physical and astronomical science—"incredibly impudent", "mere twaddle", "ludicrous explanation", "admirable for school children in a go-cart", "but I see nothing will do but lying, and plenty of it."

Aside from the probability of a feeling within him of being wrong, Newton's theory of light was not in accord with Goethe's poetic attitude towards nature. He resented Nature having her secrets wrested from her by manipulation and unnatural processes. As Helmholtz puts it, he regarded Nature as a work of art, complete in itself, and certain to yield up her central idea sooner or later to a sufficiently susceptible student. Just as a genuine work of art cannot bear retouching by a strange hand, so he would have us believe that Nature resists the interference of the experimenter who tortures and disturbs her; and in revenge, misleads the impertinent kill-joy by a distorted image of herself. He sneers at prisms and spectra and commends the experiments that can be made in the open air under a bright sun, not merely as particularly easy and particularly enchanting, but also as particularly convincing.

Throughout his speculation and theorizing about natural phenomena, Goethe always attempted to unify and coördinate, to bring many different phenomena together under the wing of one general principle or process. Among minerals, among plants, and among animals he was constantly seeking what he called an "Urtypus", or archetype, a fundamental type from which nature could, by a series of modifications, produce the myriads of forms which are characteristic of her. He spoke of an "Urpflanze", an "Urtier", an "Urbild", and the like. With respect to the "Urpflanze", or proto-plant, which he searched for so diligently in the Botanical Gardens of Palermo, and which was evidently a very real thing in his mind, he says, "The proto-plant is the most

wonderful creature in the world, for the possession of which nature itself should envy me. With this model and the key to it, new plants may be multiplied *ad infinitum*—plants of inevitable derivation which, if not yet possessing a sensible existence, are at least capable of such, plants by no means the shows and illusions of painters and poets but constitutionally real and necessary. The same law may be applied to everything organic.”

In the mineral world he erroneously recognized granite as the foundation of the Earth’s crust. All other formations were of later origin, superimposed. For this reason granite acquired for him a sentimental interest, and he spoke of himself as a “friend of granite.” Once he sat on a high and naked peak gazing over an expanse of mountains and valleys and wrote: “Here thou reposest immediately on a foundation which reaches down to the deepest places of the earth. No recent lay, no heaps of debris washed together by the water, have ever deposited themselves between thee and the firm ground-floor of the primeval world. Here thou dost not, as in those beautiful and fruitful valleys, walk over a continual grave; these peaks have never begotten and never swallowed up any living thing; they are before all life and above all life.”

Bearing in mind this brief examination of Goethe’s attitude towards science and nature, let us review as briefly Goethe’s principal contributions to science. They fall into the fields of physics, meteorology, geology, botany, and comparative anatomy. According to many of his admirers he anticipated Lamarck and Darwin in propounding a theory of evolution, although there are many who doubt that he actually entertained an idea of evolution as we now understand it.

I shall not go into detail with respect to his theory of

## 140 Goethe Centenary Lectures

colors. His ideas were then and are now recognized as being untenable. As a result of his stubborn determination to stick by his theory, and his unwillingness to retreat from the position he had taken, he laid himself open to much justifiable criticism and there is no doubt but that the theory of colors did more than anything else to discredit him as a scientist.

His theory of the weather came to him as an inspiration while sitting on a vantage point in the rugged mountains of the Tyrol, watching their summits at one time glistening in the sunlight, then enveloped in mist, then swept round with dark clouds or blackened with showers. He elaborated a theory which was perhaps more poetic than scientific; at least it was free from any taint of mathematics. He cast aside the prevalent view that the moon influenced the weather, and attributed the rise and fall of the barometer and accompanying changes in weather entirely to the action of the earth. He compared the earth and her atmosphere to a great living being perpetually inhaling and exhaling.

“If she inhale, she draws the atmosphere to her, so that, coming near her surface, it is condensed to clouds and rain. This state I call water-affirmative. Should it continue an irregular length of time, the earth would be drowned. This the earth does not allow, but exhales again, and sends the watery vapors upwards, when they are dissipated through the whole space of the higher atmosphere, and become so rarefied, that not only does the sun penetrate them with his brilliancy, but the eternal darkness of infinite space is seen through as a fresh blue.”

Goethe certainly was not literal in his use of the terms exhale and inhale. In another place he puts it differently. He believes that the mass of the earth does not exercise a constant and invariable force of attraction, but that there is,

as it were, a pulse which, due to intrinsic, necessary and probably also accidental external causes, increases or decreases. "Though all attempts by other objects to determine this oscillation [in the force of gravity] may be too limited and rude, the atmosphere furnishes a standard both delicate and large enough to test their silent operations."

In geology Goethe became interested in the process by which nature shaped the mountains and valleys. At that time there was an active controversy between the Vulcanists who believed that the process was a tumultuous and explosive one, of volcanic action, earthquakes and catastrophic commotions, and the Neptunists who considered the process to be a quiet and leisurely one, dependent mainly on the action of water. Goethe sided strongly with the Neptunists; he felt that nature always proceeded in this quiet orderly and leisurely way, without haste and without rest; volcanic eruptions and earthquakes were considered exceptional and sporadic. He seemed to regard such violent commotions rather as interruptions of nature's process than as a part of it. Goethe also speculated about the sporadic boulders strewn about in the valleys. At first he accepted the theory that they had floated in from the North on icebergs at the time of the primeval ocean, but later he developed a true glacial theory, a decade before the classic work of Agassiz, who acknowledges Goethe's priority. Goethe also was one of the first to recognize fossil bones in alluvial deposits as being what they really are, and argues that they belong to a recent epoch which is, however, in comparison with ordinary computation of time, infinitely remote. "The time will come," he wrote to his friend Merck, "when men will no longer jumble together organic remains, but will arrange them with reference to the world's epochs."

In botany, as has already been remarked in an introduc-

## 142 Goethe Centenary Lectures

tory paragraph, Goethe was struck by the idea that the various organs of a plant were essentially alike, all modifications of one fundamental type. Cotyledon, leaf, sepal, petal, stamen and pistil were but successive transformations of a single organ. This is the idea involved in his "Metamorphosis of Plants." In comparative anatomy he made a number of contributions. One day as he was rambling in a cemetery on the Lido he kicked a weathered ram's skull. It fell apart into segments, and at once the thought occurred to Goethe that the same theory he applied to plants could also be applied to animals. The skull was made up of a series of transformed vertebrae. While it is probably true that a number of vertebrae are incorporated in the hind part of the mammalian skull, the skull is by no means of vertebral origin in the sense maintained by Goethe.

The idea of progressive modification of parts was highly developed by Goethe; he considered this one of the important distinctions between living organisms and mineral substances, and calls attention to the indifference of the constituent parts of the latter as to union, coördination or subordination. In contrast, even the most imperfect organized beings take substances of different nature and assimilate them into their own substance. Their parts are arranged in an orderly manner, one following another, and all coördinated or subordinated to each other. In plants there is a fixed gradation of organs. As a plant grows, organs not only reproduce themselves but also become progressively modified, the attainment of one degree of modification being necessary before the next can be attained. Thus the reproductive function of the plant, the highest and final function, is attained while the pre-existing and preparatory organs, such as leaves, sepals, et cetera, are still full of vigorous life. In insects there is a similar series of transformations,

but in this case the successive stages are abandoned, one after the other, and instead of a higher form of structure being developed by reproduction from a lower, the lower structure is itself transformed into the higher. Thus we have the successive stages in the life cycle of an insect. In the most perfect forms of life, the vertebrates, all the organs undergo simultaneous transformations already prepared at the moment of conception. The vertebrae, for instance, begin all alike, but each one undergoes simultaneous progressive development to its mature form, influenced by its position with reference to those before and behind it.

Goethe not only endeavored to correlate and unify the parts or stages of development of a single organism but attempted to establish a somewhat similar relationship between different kinds of organisms. I have already referred to his conception of an archetypal plant which would serve as a sort of master key to every other kind of plant in the world, and his search for it. That such a type plant must exist he was convinced. "For, otherwise," he said, "how am I able at once to determine that this or that form is a plant unless they are all formed after one original type?" On this principle alone would it be possible to define orders and classes, which, it seemed to him, had hitherto been done in a very arbitrary manner. So he busied himself examining the points of similarity and dissimilarity between the many different shapes of plants, and found the former always more numerous than the latter. He had similar ideas with respect to animals. "This, then," he said, "we have no hesitation in maintaining: that all the more perfect organisms, among them fishes, amphibians, birds, mammals, and at the head of these last man, are all formed after one archetype that simply varies more or less and is continually developing and transforming itself through propagation."

In Goethe's time man was distinguished by comparative anatomists from all other mammals by the absence of a premaxillary bone in the jaw. This appealed to Goethe as highly improbable, for he did not believe that nature, with her gradual methods of transition, would break the continuity and interpose an impassable barrier in the form of an absolute distinction. He felt that the integrity of his whole philosophy of nature depended on the finding of a premaxillary bone in man. He therefore sought it and found it. His claims were at first ignored, but were soon accepted by anatomists of his time.

Many people see in these views of Goethe all the essentials of a theory of evolution, while others feel that he had no more in mind than if he had stated that all the houses on a street were built according to a single floor plan. The essential point is whether he had in mind a real notion of descent, whether he conceived of all the varied kinds of plants and animals as being actually genetically related—descended from common ancestors. Judging from the wording of various passages relative to the fundamental morphological similarities between different kinds of organisms I think that his mind did play with a genuine idea of evolution by descent. One possible bit of evidence that he harbored such an idea is contained in a letter from his close friend, Frau von Stein, to Knebel, in which she says, concerning a philosophic book of Herder's: "Herder's new work makes it probable that we were once plants and animals." No explicit statement of this kind occurs in Herder's book, and we may be certain that Frau von Stein did not originate it herself, so it seems very likely that she got it from Goethe. In another place Goethe says: "Nature can compass her purpose only in sequence. She makes no jumps. She could not, for example, produce a horse had not all the



other animals preceded on which as a ladder she ascends to the structure of the horse.”

The episode of Homunculus in the second part of *Faust* is also significant. It is the story of a bodyless mind which desires to be incorporated and become a genuine man. Acting upon expert advice Homunculus dashes his glass house against the throne of Galatea, dissolves himself in the phosphorescent sea, and comes up after the lapse of eons through the stages of lower animals to the estate of man. Galatea represents the Goddess of Love who is to preside over each stage in the upward progress. In another place Goethe says: “Animals are formed by circumstances, hence their inner perfection and their adaptation to external conditions.” He had no faith in the current anthropocentric view that interpreted everything in nature as being there for some special purpose useful to man. This idea of utility, says Goethe, is extended still further, and we ask the purpose of every single part of our organic being, thereby becoming involved in difficulties. “The question as to purpose, the question ‘wherefore’, is completely unscientific. But we get on farther with the question ‘how’. Thus man has in his skull two hollows which are never filled up. The question ‘wherefore’ could not take us far in this case, but the question ‘how’ informs me that these hollows are remains of the animal skull which are found on a large scale in inferior organisms and are not quite obliterated in man, with all his eminence.”

In view of these and many similar statements of Goethe it seems to me there can be very little reasonable doubt that Goethe did have an idea of evolution by descent, but that the idea was vague and uncertain, fluttering, as it were, on the outskirts of his mind, and never fully caught and centered for closer observation. In speaking of the origin of man with his friend Von Martius, who defended a literal

interpretation of the story of Adam and Eve, Goethe expressed disbelief in the origin of man from a single pair, for he recognized nature's lavishness not to say prodigality, in her productions—and I think he meant reproductions. He argued that it would show a better acquaintance with her ways to assume that instead of producing one paltry pair she produced men by dozens or hundreds. "When the earth had arrived at a certain point of maturity, when the water had ebbed away and the dry land was sufficiently verdant, there came the epoch for the creation of man, and men arose, through the omnipotence of God, wherever the ground permitted; perhaps on the heights first. To believe that this happened I believe reasonable; but to attempt to decide how it happened I deem useless trouble, which we will leave to those who like to busy themselves with unsolvable problems, and have nothing better to do."

In this brief review of Goethe's attitude toward science, and of his contributions to it, I have quoted extensively from Goethe's own words, lest there be any suspicion of misinterpretation or bias. I can find in these words little justification for considering Goethe a scientist, in the ordinary sense of the word, despite his unquestionable interest in scientific matters, and his extensive writings on scientific subjects. His attitude throughout is that of a poet and a philosopher. His theories are not the result of the accumulation and systematization of facts; they are rather the product of an imaginative and artistic mind, which views nature as a work of art, which reaches its conclusions by intuition and the inspiration of genius, and which has little knowledge of, interest in, or patience for scientific methods as we ordinarily understand them.

For Goethe, nature was a beautiful show, harmonious in details, controlled by a dominant motif. The motif re-

veals itself to a sympathetic observer without his going behind the scenes to examine the cords and pulleys and lighting effects and other apparatus by which the effects are produced. But these are the things that interest the scientist. As Helmholtz remarks, we must familiarize ourselves with the levers and pulleys, fatal though it be to poetic contemplation, in order to be able to govern them after our own will. This Goethe did not know how to do and did not wish to do; the use of laboratory methods in the study of nature was distinctly distasteful to him. This attitude is admirably expressed in the following lines :

Mysterious in open day  
Veiled Nature spurns thy violent endeavors;  
She tells her secret to thy mind in her own way,  
If not—of no avail are all thy screws and levers.

ASA C. CHANDLER.