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NATURE AND HISTORY *

The history of mankind is often considered as a continuation of the history of nature. In the following pages some considerations are given about the character of history (in the current sense) and nature, as well as about the method of historiography (of mankind) and of the "historical" natural sciences: geology, paleontology, etc.

A typical natural science, e.g. mechanistic physics, tries to refer the phenomena of nature to general laws, which are valid always and everywhere. This is done by reducing change to identity and by divesting events from their particular character. Science has no primary interest in individual things and particular events.

On the other hand, historiographers have emphasized that, whereas in nature the same processes are repeated perpetually, the events with which human historiography occupies itself are unique and have man (*homo sapiens*) as their only actor. Each epoch bears its own peculiar character; history does not repeat itself.

1) In practice, however, there is not such an absolute difference. We recognize in nature events possessing individuality in the logical, formal sense, and, on the other hand, there is a tendency to look for laws (general rules) in human history, especially in social and economical historiography which investigates mass phenomena and applies statistical methods. These similarities tend to blur the distinction between nature and history and to stress their continuity, providing a basis for a conformity in method: nature is "historicized" (it goes through a unique, non-repeated development) and history is "naturalized" (the history of mankind is made subject to the natural law of evolution).

* The main contents of this paper were read before the Royal Netherlands Academy of Science (Amsterdam, 9 XII 1963) and, as the Dr M. Guggenheim-lecture, before the Schweizerische Gesellschaft für Geschichte der Medizin und Naturwissenschaften (Zürich, 10 X 1964).

2) Apart from this modern, evolutionistic conception, there are other ways of conceiving the continuity of nature and history. Some people want a true historization of nature, which is considered to be possible because of the essential kinship between the human mind and the inner side of nature (whatever this may be). This romantic conception has not been very fruitful from the scientific point of view.

3) Thirdly, a "naturalization" (*Physikalisierung*) of human history was tried by Greek philosophers who considered immutable Being (ideas, forms, *logoi spermatikoi*) as the true subject of knowledge. Consequently, there is in this view no history of nature (*physis*), which is an eternal, immutable god. The eternal cycle of heavenly motions causes an eternal cycle of terrestrial events. That is, history repeats itself; another Achilles will go to Troia, another Athens and another Rome will be built.

The scientific picture of nature kept to this classical pattern up till the end of the XVIIIth century, though human historiography was not connected with it in christian tradition, which considered history as a drama with a beginning and progressing towards an end.

ACTUALISM AND CATASTROPHISM

Towards the end of the XVIIIth century a historical conception entered into the science of nature: historical geology (A. G. Werner, J. Hutton), paleontology (G. Cuvier) and cosmology (W. Herschel) arose. Right from the beginning, however, there was a divergence of opinion in the new discipline: actualism and catastrophism were the rival ways of reconstructing the past¹.

Uniformitarianism ("actualism") explains the former changes of the earth's surface by geological forces which differ neither in energy ("uniformity") nor in kind from those slowly operating causes which are still active on the earth (*causes actuelles*). One necessary consequence of uniformitarianism was that the epochs of the history of the earth had to be considered much longer than by the older theories. Uniformitarianism made "the present the key to the past" (Ch. Lyell, 1830); the addition over many centuries of the small changes occurring now before our eyes, yields the enormous changes of the geological periods.

¹ In our monograph on *The Principle of Uniformity in Geology, Biology and Theology*, Leiden 1st ed. 1959, 2nd ed. 1963, we have given a historical and critical exposition of actualism and catastrophism and their conflicts. In Britain and U.S. actualism is denoted as "uniformitarianism". Perhaps it would be useful to apply the term "uniformitarianism" to the Lyellian system, whereas "actualism" could be used for a method, which changes with the progress of geology. At any rate it will explain former changes by causes actually in operation, without deciding, however, about questions of intensity, continuity, etc. of these causes. This distinction (which is systematically made by Russian geologists) would prevent a lot of confusion.

"These operations of the globe remain at present with undiminished activity or in the fulness of their power" (Hutton, 1785) and Hutton stated as the result of his enquiry that "we find no vestige of a beginning, no prospect of an end" (1785). He compared the earth to the body of a living animal, which is wasted at the same time that it is repaired (1795). Lyell, though fully recognizing that periods of disturbance and repose have followed each other in every region of the earth, was of opinion, that "the energy of subterranean movements has been always uniform as regards the whole earth" (1830). Even further than Hutton and Lyell went G. H. Toulmin (1780), who maintained the eternity of the world: "Nature is invariably the same, by laws eternal and immutable".

This "actualism" and "uniformity" was extended to the animal world. In Toulmin's opinion individual things may rise and die, but species have always been the same, even "the human species have had, and will have, an uniform and infinite existence". Hutton too did not admit change in the animal world (perhaps with the exception of man) and Lyell was of opinion that extinct species were replaced by other species which generically resembled the old ones (1830). Consequently, the totality of the animal world does not undergo an essential change.

Actualism or uniformitarianism at that stage evidently was a-historical and therefore typically scientific: precisely as physical phenomena repeat themselves according to immutable laws, there is a perpetual repetition of slow and continuous changes in a world, which, in its totality, remains unchanged, however much local and incidental change may prevail.

Catastrophism, on the other hand, holds that the causes now in operation are not sufficient to explain the geological events of the past. Forces of a greater intensity and of a different kind were active in geological revolutions, "it is in vain that we search, among the powers which now act at the surface of the earth, for causes sufficient to produce the revolutions and catastrophes, the traces of which are exhibited by its crust" (Cuvier, 1826).

Particularly the progression of fossil animal forms (invertebrates, reptiles, mammals) and the discontinuity in this animal series (the lack of intermediate forms) seemed to indicate sudden saltatory changes (W. Buckland, A. Sedgwick, W. D. Conybeare, W. H. Miller). Catastrophism had a decidedly historical character; the earth and the organic world pass through a progressive series of unique, irreversible events.

The catastrophist Cuvier, who recognized such fast and great revolutions in nature, considered human history as relatively a-historical, and emphasized its actualistic elements. Lyell, on the contrary, who considered the changes in nature to be uniform and, in general, extremely

slow, clearly recognized the violent movement of human history, which he did not regard as a mere continuation of the history of the animal kingdom. At any rate, both of them, the catastrophist and the uniformitarian, rejected the continuity of the history of nature and the history of mankind.

EVOLUTION AND UNIFORMITARIANISM

The great evolutionists, J.-B. Lamarck (1809) and Ch. Darwin (1859), rejected catastrophism. Nevertheless, darwinism owed its historical character to the British "progressionists" (or "the geologists", as these catastrophists were called at that time). There is, according to Darwin, an irreversible series of animal forms with ramifications and even degenerations.

From uniformitarianism, on the other hand, the evolutionists borrowed the concepts of continuity and slowness of development, and it is only this latter debt Darwin and Huxley would openly recognize. T. H. Huxley's contention that "consistent uniformitarianism postulates evolution as much in the organic as in the inorganic world" is given the lie by simple historical facts (see above on Toulmin, Hutton and Lyell)².

Consistent uniformitarianism did not admit irreversible progress and, consequently, Lyell could write that progressionist paleontology would inevitably lead to the doctrine of "transmutation" of species. We are confronted, however, with the remarkable fact that the geology of the evolutionists remained true to uniformitarian orthodoxy, e.g. in Lamarck's *Hydrogéologie* (1801). This alone would suffice to prove that in Lamarck's system evolution is not the result of reaction of the animals to external circumstances (as still is contended now and again). If the environment undergoes but small oscillations about a constant average situation, it can cause but small aberrations in the paleontological series and no linear development in a special direction. The movement up the animal ladder of Lamarck's system is caused by some mystical *pouvoir de la vie*. As this movement hardly changes the total picture of the animal world, it could be easily superposed upon uniformitarian geology.

² We pointed this out in 1957 in *The Parallel between the History of the Earth and the History of the Animal World* ("Archives Internationales d'Histoire des Sciences", X, 1957, pp. 3—18). According to sir Gavin de Beer, the reason why Lyell rejected evolution was "admirably brought to light" by L. Eiseley in 1959: "Imbued with the superior value of uniformitarianism over catastrophism, Lyell repudiated the latter..." But Lyell also rejected the "uniformitarian" development theory of Lamarck, so that it is evident that not only the catastrophism of the progressionists, but the whole idea of essential changes in nature went against his conception of uniformity at that moment.

Original uniformitarianism (Hutton; Lyell, 1830) did not recognize biological evolution. So, if the two go together, biological evolution has to be made independent of geological events. If, however, an evolution under the immediate influence of external geological circumstances is admitted, it is indispensable that orthodox geological uniformitarianism be replaced by geological evolution (R. Chambers, 1844), or, if the geological doctrine is catastrophist, that evolution be catastrophist as well. In the latter case great leaps in the animal series of development have to be admitted. É. Geoffroy Saint-Hilaire (1825, 1833) considered monstrous birth (which he evoked by experiment) as a model of such an evolutionary leap. In the literal sense this is actualism (the cause of evolutionary change is still active today), though no uniformitarianism (there are suddenly violent changes). Recently, similar opinions have been put forward by the American geneticist R. Goldschmidt (1917, 1940), who spoke of "hopeful monsters", and by the German paleontologists K. Beurlen and H. Schindewolf (1936, 1950), who suppose that periods of quiet evolutionary development alternate with epochs of a "typostrophic" character when new animal types take rise.

To orthodox darwinists, however, any weakening of the idea of continuity is a horrible heresy. If necessary, the less catastrophist hypothesis of periods of an unusually high rate of evolution is preferred (Darwin; G. G. Simpson, 1944) in order to account for the gaps in the paleontological record. This led to a controversy between Darwin and some of his friends. Darwin was thoroughly convinced that the intellectual faculties of man had been gradually evolved from those of his subhuman ancestors, whereas Lyell and A. R. Wallace held that here was a leap, if not on the biological, at least on the "moral" level. Lyell deemed this no deviation from actualism, but a legitimate deduction from "the thing that is" applied to "the thing that has been": the occasional sudden appearance of men of genius led him by analogy to the hypothesis of an original leap on the psychical level from a subhuman to a human being. To Lyell this meant an adaptation of the principle of uniformity to special facts; to Darwin it amounted to the acceptance of catastrophism.

The intention of Chambers's *Vestiges of Creation* (1844) and Darwin's *Origin of Species* (1859) rather was to give a natural-scientific character to the history of nature than to give a historical character to the science of nature. The darwinistic theory of evolution is typically scientific in stressing that evolution is subject to "law", but it is "historical" in depicting the change of the animal world as a non-repetitive sequence of unique phases.

But, how then is it possible to interpret this historical element of evolution in an actualistic, more or less a-historic, sense? The answer

is: by a subtle change of the meaning of "actuality". To Darwin evolution was certainly uniformitarian, in so far as "kind and energy" remain the same, but it is not the situation that remains constant, but the change of the situation. Otherwise put: change belongs to the situation. In this way uniformity is saved.

"Uniformity" in itself is an empty word; one should know what is uniform, and what is meant by "unchanged condition". Does it mean that there are local oscillations about a constant average situation, or does it mean that a process is going on in constant tempo and mode in a certain direction? Moreover, as the early critics of uniformitarianism, e.g. W. Whewell (1831, 1837), pointed out, not even Lyell would admit absolute uniformity, and there is no possibility to fix how long a period must be taken in order that its repetition may be expressed by the word "uniformity". According to Whewell the distinction between uniformitarianism and catastrophism practically breaks down if one can choose that period at will.

In fact the increasing duration posited for the geological epochs justified the extension of the period that must be conceived as repetitive. The principle of uniformity therefore turned out to be an empty form which could be filled up in different ways. There might be e.g. cycles of catastrophic formation of mountains alternating with quiet periods of abrasion. Thus catastrophism and actualism would be blended by subsumption of catastrophes under a higher law of uniformity. In such a geological cycle, as in a stoic world period, there would be a sequence of unique "historical" situations, but on a larger scale there would be a repetition of similar proceedings. In this way this "pulse of the earth" would reassure the disturbed conscience of the actualist.

In attributing to each cycle a specific character, on the contrary, a further step towards "historization" of nature is made. As a matter of fact, even the most orthodox actualist must recognize today that in the oldest geological periods tempo and mode of change must have been different from those prevailing now: there was a primeval atmosphere probably without oxygen, so that erosion processes must have been different. And afterwards, as J. Walther (1893) pointed out, exogenic processes underwent a change as a consequence of the appearance of life. One might compare this to human history. Everything that arose in the course of history influenced events that followed, so that a mere repetition became impossible. The Restoration of the Bourbons could not reestablish the pre-revolutionary situation; the Revolution and the Napoleonic Empire had thoroughly changed the circumstances and the people. In a similar way the more recent plants and animals arose in climatological and geological circumstances widely differing from those prevailing when the primeval living beings took their origin.

Geology (and the other "historical" sciences of nature) tries to

de-historicize the series of events (for it is a science of nature). But, finding by research traces of unique phenomena, it will again and again adapt itself to them (for it is in a certain sense a historiography of nature).

If actualism is elastic enough to absorb not only evolution but even a certain amount of catastrophism, what then remains of its original conception, now that actualistic geology, like ancient catastrophism, assumes a "historical" character and recognizes the uniqueness of natural events? Strictly speaking, there remains the constancy of physical laws, that is of the micro-processes that build up the macro-processes. But even the extremists of catastrophism (Buckland, É. de Beaumont) would recognize that: "we all allow, that the primary laws of nature are immutable... and that we can only judge effects which are past, by the effects we behold in progress", but "to assume that the secondary combinations arising out of the primary laws of matter, have been the same in all periods of the earth, is an unwarrantable hypothesis with no *a priori* probability, and only to be maintained by an appeal to geological phenomena" (Sedgwick, 1831). "Ancient" causes, "different" phenomena in the past, then meant to the catastrophists that a certain coincidence of circumstances and causes at a certain point of time was unique, and that, consequently, also the events emerging from them could be different in "kind and energy" from those of the present epoch.

Ancient uniformitarianism, however, did not only propound that elementary physico-chemical processes but also elementary geological processes (erosion, sedimentation, volcanism) are always repeated in the same way. These, however, are complicated phenomena, and the more complex a phenomenon, the less probable that the many causal series coinciding in it, will coincide again at another moment. The rise of the first plants was possible by certain changes in temperature and composition of the atmosphere; this coincidence of biological and physical factors was realized only once and herein consists its "historical" character.

In his discussion with Lyell, Whewell (1840) made the distinction between "mechanical causes" (mechanical forces manifested at all times and under all circumstances) and historical causes ("the cause of the present condition and elevation of the Alps... was manifested in a series of events of which each happened but once, and occupied its proper place in the series of time"). Evidently, the mechanical causes are connected with the actualistic recurrent elements of the event, the historical causes with the unique total effect. In the series of increasing complexity: physico-chemical reactions — mineral genesis — petrogenesis — formation of mountains — the individuality and thus

the historical character of the event are increasing too. A chemical reaction may be repeated at will, the formation of a mountain possesses an individual character and may only be reconstructed in thought. "Actualism" here consists in admitting for this mental reconstruction or thought experiment only forces (causes) which are, or may be, active now. As to the rise of plants and animals, this is so complex a process, which has such a strongly "historical" character, that the model of it acquires but vague contours in our mental reconstruction.

The "principle of uniformity" evidently is no law: it propounds that something remains constant, but it does not say what this something is. Nor is it a definite theory: the course of events throughout time may be represented by a horizontal line, by an ascending line, by a curve with maxima and minima; it may be uniform or catastrophal. In all these cases it is possible to put it into an actualistic frame. It is a methodological principle, according to which the unknown past has to be constructed, as far as possible, by means borrowed by analogy from a known present.

THE HISTORY OF MANKIND

In the history of mankind the complexity, the number of independent causal series coinciding in the historical events, is so large that it has been considered one of the main characteristics of the truly historical. That is to say, if human history has "laws", nevertheless the individual deviations, the "fortuitous" events, predominate at first sight. A. A. Cournot (1872) made the distinction between the slow growth of society by inner causes (often according to statistical laws), and the contingent collisions "by chance" of independent chains of causes. The latter are those violent shocks which do not essentially change the social situation, though they may considerably alter the course of history ("*Le nez de Cléopâtre: s'il eût été plus court, toute la face de la terre aurait changé*" — Pascal). That is to say: social and cultural history is considered subject to laws, whereas the contingency of history becomes more evident in political events.

There is, however, another parallel aspect in the history of nature and the history of mankind, as both have "actualistic" as well as "historical" causality. The uniformity of human history is manifest in its elementary components (as Cuvier already recognized). Historical description uses concepts like monarchy, revolution, etc. which, in spite of their possessing a different character in different epochs and cultures, have a constancy sufficient to use them in different situations; one

describes and understands the past starting from analogous phenomena and experiences in the present.

This is even more so with relation to the inner side of historical events. The historiography of man, in contradistinction to that of nature, does not simply deal with events (registered from the outside), but with actions of beings closely akin to the historian himself. The past is reconstructed in this case in that the historian enters into the minds of the forebears, in that he re-thinks their thoughts and re-enacts their deeds in his imagination. This sympathetic understanding is only possible on the supposition that the fundamental motives of human thought, will and action, observed in ourselves and in our contemporaries, were also active in our ancestors.

There is then an analogy between nature and history: both meet with contingent, unique phenomena as well as with the general and repetitive. It is only a formal analogy, because the similarity of human feelings of love, jealousy and hatred in the present and the past is not of the same kind as that of the collision of elastic balls now and formerly. Moreover, paleontology gives a historiography of species, human historiography largely occupies itself with personalities, who do not only undergo events but in a certain measure determine and direct them and who, consciously or not, carry with them the past as a spiritual luggage, so that a new generation of men is not in the same way a continuation of the preceding one as in the subhuman world.

Besides, the actualistic elements (physical processes on the one hand — human feelings, thoughts and actions on the other) have a radically different function in the history of nature and the history of man. Consequently, the historiographic methods used to describe the one and the other must be fundamentally different. The sympathetic understanding, which lies at the basis of the historiography of mankind, is impossible with relation to stars, mountains, plants and animals and even with regard to men considered as mere biological units. One can have it only for the rational creators of culture.

Here lies one of the difficulties besetting prehistoric archeology. As there are no written records but only relics of tools (potsherds, flints), dwelling-places, etc., it shows the tendency to develop into a paleontology of implements that lead a life and go through an evolution of their own ("typology"). Moreover, the actualistic supposition that the technology of prehistoric tribes is identical with that of contemporary primitive tribes is too easily admitted. V. G. Childe (1956) warned against these errors and, besides, he pointed out that re-enactment of the thoughts of the individual is hardly possible on the basis

of cultural relics alone, as in this case "the agents are not concrete individuals, but abstract groups of persons"; "what is then recaptured and re-enacted is the objective thought entertained and realized by a society of persons".

HISTORIOGRAPHY OF SCIENCE

Historiography of science has its own problems. It is largely cultivated by scientists whose own training did not much to develop historical feeling, as e.g. the chemistry of Lavoisier is less relevant to the modern chemist than Hegel's philosophy is to the modern philosopher. On the other hand, sociologists and humanistic historians occupying themselves with the history of science are lacking in scientific knowledge, so that they do not study so much the growth of scientific ideas and methods as their impact on society and their relation with metaphysics. The sympathetic understanding, indispensable to the historian, demands that he be a scientist himself, but one who is able to enter into the circumstances and the intellectual atmosphere of the past. Of course, this is wellnigh impossible without historical and philosophical knowledge, especially when the distant past is at stake. Small wonder then that otherwise excellent historiographies of chemistry show serious weakness with regard to the scholastic period. Especially XIXth century chemists had in general little sympathy for people who tried after the transmutation of one "element" (lead) into another (gold). In the same way XXth century biologists too easily condemn fixists (Linné, Cuvier) and bestow limitless praise on transmutationists (Lamarck, Geoffroy Saint-Hilaire, Darwin) without reconstructing the past situation and without taking into account the grave methodological problems that were at issue³.

Of course, one can be too "actualistic", e.g. when modern concepts (inertia, mass, analytic chemical element) are put into the mind of predecessors who had not yet an inkling of them. Just like in the reconstruction of the geological past, one has to be careful to find out what are the truly "actualistic" elements in the thinking of the past; it is one of the things that keeps historiography lively that there is no general rule how to find this out.

Historiography of science is confronted with the contrast between the two aspects of history: with its "laws" and its "contingencies". The role of the outstanding individual is exaggerated in those historiographies which are inspired by heroworship ("Chemistry sprang forth

³ In our doctoral thesis on *The Concept of Element* (Utrecht 1933) we wrote: "A sound verdict can be passed only if one makes the effort to revive the past, to assume the philosophical standpoint of the period and to «forget» the facts discovered afterwards".

like Minerva out of the brain of Lavoisier"!); on the other hand it is sometimes reduced to that of a mere exponent of the necessity of time. It is undeniable that on many occasions it seems as if scientific ideas, theories and discoveries lead a life of their own, as if they are subject to laws independent of thoughts of individuals: the discovery of oxygen, the law of conservation of energy, the periodic system, differential calculus, natural selection, are some striking examples. But this should not blind us to the significance of great scientists: however much they are moved by their cultural environment, they are also moving it themselves.

The Russian novelist Bulgakov wrote the nice story of professor Persikov, who made successful experiments on the hatching of huge chickens. After his death his apparatus and prescriptions were found intact, but the experiments were no longer successful: "Evidently something extraordinary was wanted, which had been owned by only one man in the whole world: the late professor Persikov". It would be best to avoid dogmaticism: neither personality cult nor the other extreme is conformable to reality.

THE PERSONIFICATION OF NATURE

If there has been a darwinistic tendency to *Physikalisierung* of the history of nature, some German paleontologists, on the other hand, have made efforts at a radical *Historisierung* of nature. Stressing the individual character of geological cycles and the sudden appearance of new animal types (*Neomorphosen*) they propounded that "the course, structure and meaning" of the history of the earth, of life and of mankind, are the same, so that the events of nature are "really historical" (E. Becksmann, 1939), and that there are "cosmic persons" (C. C. Beringer). These vitalists pointed out that the current "mechanistic" geology and paleontology do not lead to a real historiography, but they forgot that their so-called *Historismus* is as well a *Naturalismus* as the view of their opponents. Both consider human history as a simple continuation of the history of nature.

In historiographic method their standpoint was sterile. Towards non-human things the power of sympathetic imagination, of identification with the innermost of the subjects of investigation, which characterizes historiography in the proper sense, is lacking. When these subjects have thoughts, these are at any rate inaccessible to man: "Do you wish to understand the true history of a neolithic Ligurian or Sicilian? Try, if you can, to become a neolithic Ligurian or Sicilian in your mind. If you cannot do that... content yourself with describing and arranging in series the skulls, implements, and drawings which have been found belonging to these neolithic peoples" (B. Croce, 1912).

That is to say: if prehistoric archeology cannot wholly accomplish its historiographical task, it is for lack of data but not because of an essential impossibility. Historiography is possible in so far as there are relics which may establish the spiritual contact with the people of the past; relics of primitive man, even of primitive *homo sapiens*, without any relation to traces of culture, are but subjects of paleontological research.

With non-human subjects the different situation is clear at once, and therefore we cannot draw the parallel as far as is sometimes done: "Do you wish to understand the true history of a blade of grass? Try to become a blade of grass, and, if you cannot do it, satisfy yourself with analysing its parts, and even arranging them in a sort of ideal or fanciful history" (Croce). There is a history of nature (the earth, the animal world, etc.) only in that there is uniqueness and individuality of phenomena in the course of time. Consequently, historiography of nature cannot go farther than a purely outward contemplation. Even if there were a "true history" of blades of grass, the earth, etc., its true historiography would be impossible by sheer lack of spiritual contact between the historian and his subject of investigation.

From the purely formal point of view, however, "historiography" of nature and of mankind meet each other in the methodological principle of actualism, which enables both of them to construct a picture of the "history that does not repeat itself" by means of "history that repeats itself".