The Optical Work of Charles Tulley

By H. C. KING, Esq.

ABSTRACT of Paper read on 7th June, 1949

Charles Tulley, a London optician of the first half of the 19th century, played a small but effective part in the development of the achromatic telescope.

When the Astronomical Society received in 1822 a 2-inch blank of flint glass from Guinand, Tulley, already a Member of the Society, was invited to work it into a concave component for an achromatic doublet. The Society was impressed by the performance of the glass but not with its size. When a 7¼-inch blank arrived from Guinand, Tulley was asked to mate it with a convex crown. This he effected to the Society's satisfaction, but Tulley's charge of £200 for the work was considered excessive. Fortunately, the Rev. W. Pearson bought the glass and so prevented what might have been a serious dispute. Of 6·8 inches clear aperture, this object-glass remained Tulley's largest. From Pearson the telescope passed to Capt. W. Noble and then, in 1855, to L. Prince, who erected it at the Crowborough Hill Observatory.

Tulley made several fine object-glasses for Sir James South. In 1822, Tulley completed a 3¼-inch, F/14 aplanatic doublet based on John Herschel's computation—the first glass of its type. South received two large (for those times) flint blanks from Paris; these Tulley used for the concave components of a 5-inch and a 5·9 inch object-glass. South considered that the former was the finest of its type. The latter he sold to W. H. Smythe, author of the "Cycle of Celestial Objects".

Tulley competed with Cary, Watson and T. and W. Harris in the manufacture of reflecting telescopes. William Kitchener spoke highly of the performance of his 7-inch Tulley Gregorian and 15-inch Cassegrainian. From the undated price list of Tulley's reflectors which Kitchener published in 1825, it appears that Tulley marketed 9-inch aperture Gregorians and 10-inch aperture Newtonians.

We know little of Tulley's method of glass-working. He appears to have adopted the time-honoured and wasteful trial and error methods of his predecessors. His workshop was at Territt's Court, Islington, where, assisted by his two sons, he spent, in company with George Dollond, Sir John Herschel and Sir James South, many hours testing object-glasses on close double-stars. He died in 1832 or 1833. The business continued under William Tulley, the first optician to market achromatic microscope objectives, but ceased upon the death of the younger son, Thomas Tulley, in 1846.

The Anatomy of Geology

By Dr. S. I. TOMKEIEFF

ABSTRACT of Paper read on 24th October, 1949

The word "anatomy" in Greek means "dissection". In the present discussion "anatomy of geology" stands for a logical dissection of the science of geology under the guidance of historical method, with the object of discovering its fundamental framework or structure. Such an inquiry differs from the one entitled "philosophy of geology" which is often applied, not to the analysis of the logical structure of the science of geology, but to the general discussion of the objects of the science of geology. However important such

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discussions may be, they belong to the realm of metaphysics or to the science of being in general. On the other hand works dealing with geology in its social setting, as related to the needs of mankind, obviously belong to that branch of philosophy which deals with intentions and actions, namely ethics. Again geology, together with other natural sciences, may be studied from the standpoint of the theory of knowledge, methods of research and methodology in general. Such inquiries obviously belong to epistemology. Finally we can attempt to trace the logical structure of geology in its internal aspect and study the " order of concepts " coordinated and reflecting the " order of nature ".

The subject matter of a logical study involves general concepts or universals. These, being abstracts of reality, and therefore major parts of it, are in a sense more real than the particulars in which they are manifest. These universals, coordinated into a system, form the framework of the science, which through the medium of categories—forms of scientific intelligibility—constitute its matrix. By following the main trends in the history of science one can discern its principal categories and the leading ideas in its development and in this way discover its logical structure.

The history of geology can be considered under three heads :—(1) the study of the materials which enter into the composition of the earth, (2) the disposition of these materials, and (3) the genesis of these materials, or, more generally, the processes occurring in the earth. These three aspects may be said to answer three pertinent questions about Mother Earth—what is it ? where is it found ? and, how was it formed ?—questions constantly asked by the geologist and layman alike from the very beginning of human history.

Geology as an organised science originated in the second half of the XVIIIth century. The great creative period in its history—the Heroic Age of Geology—covers approximately the period of fifty years (1775–1825). This period coincides with the Industrial Revolution and the Romantic Revival. Geology is closely connected with these movements and like them is a manifestation of intellectual ferment and reconstruction of the material bases of the Western Society. The emergence of the new geology is an event of major importance not only in the history of science, but in the history of human culture and technology. The new geology opened the way for the extraction of enormous quantities of coal, petroleum and metals, the material pillars of modern civilisation. It was only through the development of stratigraphy and palaeontology that the emergence of the modern theory of evolution became possible and with it the changed intellectual outlook of mankind.

The success of the new geology is almost entirely due to its internal logical framework, the framework of ideas and methods.

This in its turn is due to the synthesis of the three principal aspects of geology—material, disposition, process. Three names stand out as closely associated with the three aspects and a fourth, with the great synthesis. A. G. Werner (1749–1817) who, by simplifying the system of mineralogy made the science of rocks possible, and paved the way to the true study of the material of the earth ; William Smith (1769–1839) was the first to suggest that fossils could be used for dating strata, thereby making the science of stratigraphy possible and geological mapping practicable ; and James Hutton (1726–1797), by giving a rational explanation of various geological processes, was able to arrange them into an all-embracing cycle which subsequently became the foundation of the new science of geology. Finally it was Charles Lyell (1797–1875) who produced a harmonious synthesis of these three aspects by amalgamating all that was sound in the work of the previous authors and in this way established the principles of geology.

The most fundamental contribution to the new geology is the dynamic scheme as outlined by James Hutton, the so-called " geostrophic cycle "—the cycle of changes in the earth in which the rocks exposed at the surface through the process of weathering, denudation and transportation are deposited, consolidated and eventually metamorphosed and even magmatised and again brought to the surface of the earth. The geostrophic cycle, which can be diagramatically represented by a circle with directional arrows separating processes from products, provides us with the logical core of the science of geology, in which the " order of nature " is reflected and transmuted by the mind into an " order of concepts ". This provides a scheme which explains the relation of the science of geology to its subject matter. Another scheme, which explains the internal structure of the science of geology and the relation between geology and other sciences, is provided by the " geological octahedron ". This is a model of an octahedron with sides placed horizontally (the lower side is left open and the octahedron is balanced on a needle, the point of which is placed in the middle of the lower surface of the upper face). The upper triangle of the octahedron represents the science of geology, the three aspects of which—material, disposition, process—are placed at its corners. The lower triangle, with its three corners occupied by chemistry, physics and biology, represents the fundamental sciences of nature upon which geology rests. Looking at such a logico-mathematical model one can easily discern the definition of geology as a science which investigates the MATERIAL constituents of the earth, their DISPOSITION and the PROCESSES involved in their formation and distribution.

History of Science in Education

ABSTRACTS of Papers read at the Discussion held on 27th February, 1950, in the Lecture Theatre of the Royal Institution of Great Britain.

By PROFESSOR H. DINGLE

Professor of the History and Philosophy of Science, University of London

Professor Dingle, in opening the discussion, emphasised the difference between the historical development of science and its development as a logical system from fundamental axioms or postulates. Of necessity the latter must take pride of place in the training of students for immediate practical work, but the opportunity should not be lost of pointing out that what guided the pioneers in making fresh advances was very rarely what appeared later to be the logical requirements of the situation, but was frequently the impact of considerations once important but now largely forgotten. An example was found in the theory of heat. It is not uncommon for text-books to present Rumford's experiments on the boring of cannon as having given the death-blow to the fluid theory, because we can now see clearly that those experiments are far better explicable in terms of a kinetic theory. In fact, however, neither Rumford himself nor his contemporaries drew this conclusion and the fluid theory lasted for another half-century until it was overthrown by the new doctrine of energy.

Professor Dingle then gave an outline of the courses in the History and Philosophy of Science at University College, London. These were postgraduate courses leading to M.Sc. and Higher Degrees, and were open to students who had graduated in a scientific subject. Beginning in a comparatively small way in 1925, the Department now had a staff of six full-time teachers, as well as assistance from visiting Lecturers, and an enrolment of about 50 students. Its appeal extended to the most distant parts of the world and clearly indicated

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