

"We shall work to ensure that the co-operation among the scientists of so many countries which is developing to-day shall be a model for the integration of the world scientific effort after victory has been won."

NEWTONIANISM AND SCHOLASTICISM

IN his presidential address to the annual statutory meeting of the Royal Society of Edinburgh, under the title "Aristotle, Newton, Einstein", Prof. E. T. Whittaker compared the modern revolution in physics, by which the ideas of relativity and the quantum theory have displaced those of Newtonian mechanics, with the revolution in the seventeenth century when Newtonian mechanics triumphed at the expense of Aristotelian Scholasticism. His main thesis was that the Scholastic ideas which were destroyed by the movement of which the work of Newton marked the culmination, were a perverted form of the true philosophy of Aristotle, and that the modern outlook represents a return—or at least a tendency to return—to the true Aristotelian outlook. The work of Tycho and Kepler disproved and overthrew the existing Scholastic cosmology, but it contained nothing inherently irreconcilable with the Scholastic metaphysics and might conceivably have been absorbed into the philosophy of the Schoolmen by a peaceful and conservative revolution. Actually, however, what was essentially a new metaphysics was introduced. The basic postulate of the Newtonian mechanics, in which it differed sharply from Scholasticism, was the fundamental and independent status accorded to space and time. Persistence of bodies in time and their displacement in space became the concepts to which everything in the external world had to be reduced, and bodies moved in obedience to the forces which acted on them in space and time.

A partial return to the Aristotelian view that all change is a transition between a state which is potential and a state which is actual came with the doctrine of the conservation of energy, in which force is ignored and a change is represented by a transition between potential and other forms of energy; and this tendency has more recently been emphasized by the quantum mechanics, in which the operator corresponding to classical potential energy is closely akin to the Aristotelian concept of potency. The introduction of 'minimum' principles, which culminated in 1915 when Hilbert introduced a 'world function' which determines all physical events in the universe by the condition that its integral taken over the whole of space-time is a minimum, marked another drift back to Aristotelianism, since such principles, like Aristotle's, are essentially teleological. General relativity, according to which gravitation represents a continual effort of the universe to straighten itself out, is so completely teleological that it would certainly have delighted the hearts of the Schoolmen. A free particle, in relativity theory, moves in a path determined solely by the curvature-properties of space; it is, as the Aristotelians would say, *in potency* with regard to space.

The importance of quantum theory from this point of view is that it shows that there are events in the physical world which cannot be represented on the background of space and time. Space and time must accordingly be deposed from the dominant position

which they held in Newtonianism. We must begin not with space and time but with events; and the atom, which has a potency of various states, is correlated to the states as potency is to act. It endures as the atom, while it takes different states in succession. Thus, the proton and neutron are now regarded as two 'states' of a single entity, often called a 'heavy particle'. In Aristotelian terms, the heavy particle would be 'matter' and its determinations as a neutron or proton would be its two possible 'forms'. Matter is correlated to form as potency to act.

The peculiarities of modern statistical theory also are conveniently expressible in Aristotelian language. An electron can freely interchange its recognizability with other electrons; it has no sameness of being, no proper identity, no separate history. Its selfhood is merged in an electronhood which it shares with all other electrons, and which is correlated with it as potency to act. This reopens the question which engaged so much attention in the Middle Ages, regarding the nature of *universals*, or general terms, which represent the common basis of a class of individual objects.

Prof. Whittaker considers that these tendencies of modern physics should lead to more intercourse and mutual understanding between men of science and philosophers; for of all types of philosophy, the Aristotelian-Scholastic is, in its principles, the most congenial to the scientific mind. It is in a sense true that correct, even if in some respects limited, knowledge regarding physics can be combined with any view whatever on the fundamental questions of being and reality, but the effect of such segregated thinking has been to make science a departmental affair, having no influence on life and thought except indirectly through its applications. At the present time there is a movement in scientific circles aiming at securing for science a greater influence on human affairs, and even calling for a refounding of civilization on a scientific basis; but its advocates do not always understand that, as a necessary condition for the possibility of such a reform, science must be reintegrated into a unity with philosophy and religion.

ESKIMO CRANIOLOGY

THE first part of a catalogue of human crania in the United States National Museum was issued in 1924. It gave measurements of four short series from parts of Alaska. Since then the Smithsonian Institution has sent eighteen anthropological expeditions to the country, and the United States National Museum now has 2,200 Eskimo skulls, many of which are accompanied by the rest of the skeleton. The latest part of the catalogue to be issued* provides individual measurements of the whole collection of skulls, including a number for which data had been published previously. Dr. Hrdlička, the doyen of American physical anthropologists, has thus made another substantial contribution to the long list of his achievements in collecting, describing and analysing the material of his science.

For each specimen nineteen absolute measurements and twelve measurements of shape (indices and angles)

* *Proc. U.S. Nat. Mus.*, 91, 169-429 (1942). "Catalog of Human Crania in the United States National Museum Collections: Eskimo in General", by Aleš Hrdlička. (Washington, D.C.: Gov. Printing Office.)

are given. The set of characters which should be recorded in craniometric studies has not been standardized, and a fuller list has frequently been used. The aim in all cases has been to give a general description in metrical terms of the skull as a whole and of all its principal parts, such as the brain-box, orbits, nasal aperture and so on. Owing to the lack of international agreement, the same character has sometimes been measured by different observers in two or more ways, thus making the data less useful than they might have been with the same expenditure of labour. In spite of these drawbacks there is extensive comparative material for nearly all the measurements given in the Eskimo catalogue.

Scientific workers other than anthropologists are unlikely to have any just appreciation of the scope and uses of such records. There has been no convenient digest of them, and the problems of racial history which they should elucidate apparently remain obscure. All countries in the world are represented by well-described series of skulls, and those long enough to give a reasonably good representation of a population—series comprising fifty or more fairly complete specimens of one sex, say—range from about 5000 B.C. to modern times. The peoples that have been best described in this way are the ancient Egyptian (about 5,000 specimens), Eskimo (Hrdlička, and Fürst and Hansen, 3,000), British (3,000) and Norwegian (Schreiner, 2,500). The number of Eskimos is now considerably greater than that for all other American peoples put together, if artificially deformed skulls are left out of account. It is fortunate for anthropologists that the arctic population did not adopt the unnatural practice which was common in most other parts of the continent.

Study of differences between the physical characters of Eskimo communities may be expected to throw light on the problem of the peopling of America. Dr. Hrdlička has discussed this matter at length elsewhere and he refers to it briefly in the notes appended to his new catalogue. Considered as a whole, the Eskimo population has long been recognized to be of a specialized type, as are the isolated human populations found in other remote parts of the world. The typical skull is characterized by a median ridge on the vault, and the great breadth and large size of the facial skeleton are other striking peculiarities. In spite of the basic similarity of the type throughout the population, average measurements given for local groups reveal clear differences in some characters. The cephalic index in particular makes many distinctions which are markedly significant. In general it is higher in the west and lower in Greenland, though the lowest value is for an Alaskan series which is also distinguished by being the oldest. It is assumed that the group must have spread in relatively recent times on account of linguistic and cultural similarities over all its present region. The inference is that the mixture or changes which led to physical diversity "took place not on the American continent but well back in the original habitat of the people, which doubtless was Arctic Asia". Although the evidence is fairly extensive already, it is necessary to ask for more—relating particularly to older Eskimo and related peoples—before skeletal material can be expected to reveal clearly the racial history of Eskimos in America. In considering such questions the need for fuller knowledge is constantly felt.

The cranial measurements given in the catalogue are not analysed statistically there, but they might

be used to illustrate the essential nature of all modern populations of *Homo sapiens*. Variation within any subgroup is found to be very considerable, the range for any metrical character being not less than half the range for the total species. The more isolated populations, such as the Eskimo, are found to be only slightly less variable than those of Europe. Gradations within the culturally defined group, and also between it and neighbouring groups, are always observed. Anthropological data supply innumerable examples of character-gradients (or 'clines' as Huxley has recently named them), and it is owing chiefly to their existence that no agreement has yet been reached regarding the way in which races of modern man can best be defined.

Geneticists have hitherto taken little interest in polygenic characters such as cranial measurements, and it has not been shown that any skeletal characters which anthropologists might use for their special purpose are other than polygenic. A few characters of living people controlled by small numbers of genes are known, but there can be little hope of disclosing any details of the course of racial history by treating them alone. Evidence of a palaeontological kind seems to be essential for that purpose. It may be anticipated that data such as those placed on record by Dr. Hrdlička will be used by future generations of anthropologists, even if they treat them by methods as yet unimagined.

G. M. MORANT.

FORTHCOMING EVENTS

Saturday, January 9

ASSOCIATION OF SCIENTIFIC WORKERS (in the Lecture Theatre of the London School of Hygiene, Keppel Street, London, W.C.1), at 2.15 p.m.—Conference on Problems connected with the Organisation, Application and Personnel of the Medical Sciences. (Chairman: Dr. D. McClean.)

Monday, January 11

ROYAL GEOGRAPHICAL SOCIETY (at Kensington Gore, London, S.W.7), at 5 p.m.—Discussion on Flying Maps.

Tuesday, January 12

INSTITUTION OF CIVIL ENGINEERS (at Great George Street, Westminster, London, S.W.1), at 2 p.m.—Sir Charles G. Darwin, F.R.S.: "The Extreme Properties of Matter" (James Forrest Lecture).

SOCIETY OF CHEMICAL INDUSTRY (CHEMICAL ENGINEERING GROUP) (JOINT MEETING WITH THE INSTITUTION OF CHEMICAL ENGINEERS) (at the Geological Society, Burlington House, Piccadilly, London, W.1), at 2.30 p.m.—Dr. H. Ter Meulen: "The Solvent Extraction of Lubricating Oils".

ILLUMINATING ENGINEERING SOCIETY (at the E.L.M.A. Lighting Service Bureau, 2 Savoy Hill, Strand, London, W.C.2), at 5 p.m.—Mr. H. C. Weston: "Proposals for a New Lighting Code".

Wednesday, January 13

ROYAL SOCIETY OF ARTS (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Mr. Anthony Hurd: "Agriculture To-day and To-morrow", 3: "Research and the Farmer".

Thursday, January 14

PHARMACEUTICAL SOCIETY (at 17 Bloomsbury Square, London, W.C.1), at 7 p.m.—Mr. F. H. Cotton: "Synthetic Rubbers".

Friday, January 15

ROYAL SOCIETY OF ARTS (JOINT MEETING OF THE INDIA AND BURMA SECTION WITH THE EAST INDIA ASSOCIATION) (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Mr. Maurice Yeatts: "The Indian Census of 1941".

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

LECTURER IN MECHANICAL ENGINEERING in the Oxford Schools of Technology, Art and Commerce—The Chief Education Officer, City Education Office, 77 George Street, Oxford (January 17).

DIRECTOR of the National Froebel Foundation—The Secretary, National Froebel Foundation, 2 Manchester Square, London, W.1 (February 27).

CHAIR of MINING—The Secretary, the University, Edmund Street, Birmingham, 3 (March 1).

SPEECH THERAPIST—The Education Officer, County Hall, Warkfield.