Inorganic)", Dr. M. A. Whiteley ("Ultimate Organic Analysis"), and Mr. E. W. Yeoman ("Gas Analysis"). It is a substantial article, and a substantial contribution to the literature of chemistry. In a work of such magnitude as the "Encyclopædia", the definition of boundaries must have presented considerable difficulties in seeking to provide for a thorough survey of the borderland between one science and another; those regions lying between chemistry and engineering, or between chemistry and economics, for example, have acquired an importance second to none in the industrial outlook, both of the English-speaking and of other peoples. Due regard has been had to such common issues, but only a careful and exhaustive analysis of the treatment of cognate subjects shared both with other sciences and with other human interests would show whether the impression that little of first importance has been overlooked is accurate. Ions, although discussed incidentally, have (except in regard to their catalytic action) scarcely been accorded their usual place of honour in chemical

theory; whilst noticeable, this is doubtlessly completely devoid of significance.

Allusion to the relation of chemistry to other human interests invites reference to the article entitled "Chemical Warfare", by Brig.-Gen. Sir H. B. Hartley and Mr. C. G. Douglas, where developments resulting from the use of gas as a military weapon by the German Army are described, together with measures adopted for protection against its effects. In view of its efficacy as an arm in the field, the probability of its proving equally potent when used in conjunction with aircraft against industrial centres or even against the civilian population, and the ease with which chemical industry organised for essential national requirements in times of peace can be converted into an arsenal in time of war, the possibility of the future use of military gases in spite of international agreements is one which, we are warned, is felt not to be remote. Until the danger is effectively removed by statesmen, it will remain all too obvious to chemists. A. A. E.

The Climate of the Pleistocene Period.*

THE glaciation of northern Europe during the great Ice Age was due to a shift of the pole associated with appreciable variations of solar radiation.

The shift of the pole brought Europe into sufficiently high latitudes to permit of the formation of an ice sheet; but the large variations of climate during the Ice Age, as shown by the interglacial periods, were due to the oscillations of the solar energy.

If two complete cycles of solar radiation occurred during the Pleistocene period, it is possible to account for four advances of the ice in the Alps as demonstrated by Penck and Bruckner, but the interglacial periods were not all warm. The Günz-Mindel and the Riss-Würm interglacial periods occurred at the maximum of the solar radiation, and were, therefore, warm interglacial periods; but the Mindel-Riss interglacial period occurred at a minimum of solar radiation and was, therefore, a cold interglacial period.

At a maximum of solar radiation, that is, during a warm interglacial period, the climate of north-west Europe was warm and very wet, with a relatively small annual variation of temperature. As the intensity of solar radiation decreased, the mean temperature fell and the annual variation of temperature increased.

* Summary of an address delivered before the Royal Society of Edinburgh on June 16, by Dr. G. C. Simpson, F.R.S.

At the same time the amount of precipitation decreased. The fall of temperature occurred sufficiently rapidly compared with the decrease in precipitation to cause the glaciers of the Alps to advance and for an ice sheet to form over Scandinavia. As the solar radiation still further decreased, the lack of precipitation caused the glaciers of the Alps to retreat. At the minimum of solar radiation, there was a cold interglacial period with low mean temperature, a large annual variation of temperature and very low precipitation. In fact, a truly continental climate.

With these changes of climate went a corresponding change in the flora, the sequence being: park land, forest, tundra, grass with sparse trees, and steppe. In this way it has been found possible to determine a sequence of climates and of fauna and flora for the whole Pleistocene period which is supported by the geological and archaeological evidence available. In particular it is possible to arrange the sequence of human culture, the geological strata of East Anglia, and the history of the ice in the Alps into the scheme of climate change.

The two maxima of solar radiation were accompanied by increased precipitation in all parts of the world, so accounting for the two pluvial periods which are known to have occurred during the Pleistocene period.

The Mechanism of Variation.¹

By Prof. HENRY H. DIXON, F.R.S.

THE fundamental work on the production of variants by means of X-rays and the γ -radiation of radio-active substances, which has been chiefly carried out during the last two or three years in America, is of profound interest to all students of biology. By these means H. J. Muller found it possible to increase 150 times the minute amount of natural variation which is only accessible to estimation by laborious searching through tens of thousands of individuals. It was observed that these variations were completely fortuitous, occurring in any characteristic, in any direction, some quite new, some known as occurring under natural conditions, some losses, some gains, but numerically proportional to the duration of radiation, or to the amount of air-ionisation produced by the radiation used.

Variations produced by this method are transmitted in breeding experiments to the offspring according to the known laws of heredity, so that there is no doubt that they are represented in the germ-plasm by factors or genes. They have been transmitted unaltered through fifty generations. Changes in the chromosomes, corresponding to observed disturbances in linkage, show that the radiation alters the characteristics through alterations in the architecture of the germ-plasm. Breeding experiments emphasise the random nature of the changes, since it has been shown that one gene, of two lying side by side in a chromosome, may be changed; while its *vis-à-vis*, not the thousandth of a millimetre distant, has remained unaltered. The same gene in adjacent cells may also escape modification.

This random, but minutely selective, action is just what might be expected to result from disturbances in the germ plasma due to the expulsions of electrons by the short waves of X-rays, γ -rays, and cosmic rays. The great preponderance of lethal variations observed over viable and useful ones is only to be expected when we reflect on the necessary bewildering complexity of structure of the genes and the randomness of the dislocations produced by the radiations.

Short-waved radiation (X-, γ -, and cosmic radiation) is then a *vera causa* of variation, and just as in the experiments of Muller, Stadler, Goodspeed, Olson, etc., all manner of variations are produced and even the same variations repeated, so in nature the similar, but less intense, radiation is responsible at relatively long intervals for similar variations.

With the aid of this fundamental new knowledge we have a ready explanation of many of the old-standing difficulties in the path of the evolutionist. The occurrence of similar morphological features in divergent lines of descent has produced much discussion and has been variously explained as due to homoplasy or innate tendencies, etc. According to this new departure, radiation acting on the germ plasma is responsible. The architecture of the germ plasma of the divergent lines of descent is fundamentally similar. Radiation causes all manner of fortuitous variations—mostly lethal, and a limited number viable. Hence in the lapse of time some of those which are viable and possibly advantageous recur in the diverging lines. In the same way many atavisms and instances of parallel development may be explained.

The possession of common morphological characters by the individuals of certain groups, otherwise considered to be genetically far apart, has led to the self-contradictory conception of polyphyletic groups and genera. Viewed in the light of this new principle, however, such resemblances are due to nothing else but the reappearance of the same variation conditioned by changes in the genes by the short-waved radiations of Nature. Inasmuch as the majority of these variations are lethal, the number of the viable ones are limited and must recur repeatedly as the phylogeny is extended.

Again, instances of discontinuous distribution must often find their explanation in this recurrence of the same variation in different localities.

In quite a different domain of evolutionary study, this principle may be called in to supply an explanation of the relatively high number of endemics which are said to occur on high mountains. Naturally, since variation is proportional to radiation, locations on mountain-tops being screened from cosmic radiations by a shallower atmosphere should exhibit a greater number of variations than similar areas on the plains.

It has often been pointed out that the uselessness of the intermediate stages in the development of a useful organ constitutes a serious difficulty in the theory of evolution based on the natural selection of accumulating minute variations. But the conception of variation arising from within due to intramolecular changes in the germ-plasma removes this difficulty. It is quite conceivable that a gene, if only it retains viability, will be so altered as to condition the production of a useful character or organ without any intermediate steps being necessary.

¹ Last spring when the work of Goodspeed and Olson called my attention to the causation of variation by X-rays, I suggested (NATURE, June 29, 1929, p. 981) that cosmic radiation is a factor in the production of variation by direct action on the germ-plasma. At the time I did not know that this suggestion had been made and had been experimentally substantiated by the brilliant work of the American investigators whose results are summarised in this communication.—H. H. D.

University and Educational Intelligence.

BELFAST.—Mr. J. G. Semple, lecturer in pure mathematics at the University of Edinburgh, has been appointed professor of mathematics.

CAMBRIDGE.—The following reappointments are notified: Mr. L. E. S. Eastham, Trinity Hall, as university lecturer in advanced and economic entomology; Dr. T. M. Harris, Christ's, as demonstrator in botany; Mr. H. L. H. H. Green, Sidney, as demonstrator in anatomy; Dr. S. M. Manton, Girton, as demonstrator in comparative anatomy.

The vice-chancellor announces that the Quick professorship of biology will become vacant next November, when the period of three years for which Dr. Nuttall was last elected will have ended. A meeting for the election of a Quick professor will be held on July 16.

The vice-chancellor also gives notice that the Downing professorship of medicine is vacant by the death of Dr. Bradbury.

The Woodwardian professorship of geology will become vacant in October by the resignation of Dr. Marr.

At Trinity Hall, Mr. C. Forster Cooper, having resigned the office of bursar, has been elected to a non-stipendiary fellowship, and Dr. O. H. Wansborough-Jones has been elected to a research fellowship.

LEEDS.—The foundation stone of the new library building presented to the University by Lord Brotherton of Wakefield was laid by the donor on June 24. The Duke of Devonshire, Chancellor of the University, presided, and the meeting was addressed by him and by the vice-chancellor, the librarian, and Lord Brotherton. The vice-chancellor remarked that "Through the munificence of the Lord Brotherton of Wakefield this University will in a short time be in the possession of a library building worthy of the highest aspirations of its scholars, its scientists, and its students, adequate to meet the requirements of the complete development of the University in the future, unsurpassed if not unrivalled by any similar institution in this country." A striking innovation is the fact that it will be possible to place a quarter of a million volumes on shelves that are open to the access of all readers. A generous donor has given to the University a fine collection of Icelandic books which will find their place on the shelves of the new library building. Lord Brotherton announced that it is his intention to house his own collection in the new library, to be held by the University in perpetual trust for the nation. It is his desire that access to the books shall be accorded to all properly accredited persons. With this end in view, Lord Brotherton is taking the necessary steps to endow the collection.

LONDON.—The following doctorates have been conferred: *D.Sc. in Chemistry*, Mr. Harold Burton (Guy's Hospital Medical School) and Mr. C. W. Shoppee, an external student. *D.Sc. in Soil Bacteriology*, Mr. H. G. Thornton (Rothamsted Experimental Station). *D.Sc. (Engineering)*, Mr. C. H. M. Jenkins (Imperial College—Royal School of Mines) and Mr. Burrows Moore (King's College). *D.Sc. in Botany*, Mr. C. R. Darlington, an external student.

Prof. J. K. Catterson-Smith has been appointed as from Aug. 1 to the University chair of electrical engineering tenable at King's College. Prof. Catterson-Smith was educated at the City of London School, the South-Western Polytechnic, and the University of Birmingham. Since 1923 he has been professor and head of the Department of Electrical Engineering at the Indian Institute of Science, Bangalore, of which he has also officiated as director.