

unaffected by carbon particles sputtered from arc lights.

By means of a specially devised technique, Mr. A. W. Hothersall (Britain) showed that the adhesion of electro-deposits to nickel surfaces may be notably decreased by the presence of an invisible oxide film on the latter, and for securing the highest adhesion he recommended anodic etching of the nickel in sulphuric acid solution, the current being finally reversed for a moment. The special difficulty in securing adhesion of electrodeposits to chromium and its alloys is also due undoubtedly to the presence of an oxide film, and in order to overcome this Mr. G. E. Gardam (Britain) recommended cathodic treatment of the degreased surface in strongly acid nickel sulphate solution at high current density, which causes simultaneous removal of the film and deposition of nickel. It is advantageous to deposit a layer of copper (from the acid bath) on the resulting surface before plating with nickel from the regular nickel bath.

M. P. A. Jacquet (France) has established that whereas on a practically amorphous copper surface, produced by mechanical polishing, electrodeposition of copper begins from randomly distributed nuclei; a surface which has been electrolytically 'smoothed' by his method of anodic treatment in phosphoric acid retains its original crystal grain structure, and this structure is continued when copper is electrodeposited on it from the acid bath. In the initial stages of deposition, the deposit forms preferentially on grains which are favourably orientated with respect to the surface, and the character of its growth is affected by this orientation. Modifications of the phenomena observed when 'aged' baths are used are attributed to the presence of cuprous ions.

The various modifications of the crystal structure of electrodeposits which may arise through inclusion in the deposit of substances added to the bath (addition agents) or of insoluble substances formed in the solution adjacent to the cathode surface, were shown in a remarkable series of photomicrographs presented by M. M. Cymboliste (France). Such inclusions are classified with reference to their character, origin and effect on the structure and properties of the electrodeposit; and the effects of varying the conditions of electrolysis are interpreted in terms of the influence of these conditions on the formation of inclusions. Prof. A. Phillips and Mr. W. R. Meyer (United States) reported results of an investigation of the upper limits of current density at which copper deposited from the acid bath on a copper surface ceased to continue the structure of the basis metal. From the cyanide bath no such continuation of structure was observed even at very low current densities. Even minute traces of lead in the acid copper bath were found to affect the character of the copper deposit, tending to make it dense, bright and somewhat brittle; but notable amounts of zinc in the bath scarcely affected the structure.

Papers by Dr. N. A. Isgarishev (U.S.S.R.) and by Prof. A. Glazunov (Czechoslovakia) and Dr. M. Schlötter (Germany) dealt with the mechanism of deposition of metals from complex salt solutions; and contributions from Prof. L. S. Ornstein in collaboration with B. Baars and P. J. Haringhuizen (Holland) were concerned with a comparison of the behaviour of electrodeposited and evaporated metallic films towards corrosive agencies, which had been investigated by means of a specially devised optical method.

## Permanence of Oceanic Basins and Continental Masses\*

IN his presidential address to the Geological Society of London in 1870, Huxley brought into correlation with geological science the scheme of zoological provinces which he had proposed to the Zoological Society two years before. He recognized the fact that the distribution of life, as then known, implied "a vast alteration of the physical geography of the globe", but he nevertheless conformed to the orthodox view of the time regarding the persistence of a general uniformity in the positions of the four great oceans from Devonian or perhaps earlier times.

That the oceanic basins and continental masses had, from the earliest geological times, occupied their positions, with little more than marginal changes, was an idea that originated in its geological bearing with J. D. Dana in 1856. Taken in conjunction with the then prevailing notion, developed by W. Hopkins, that the earth was solid to great depths, the doctrine of permanency persisted for many years unchallenged; it is still held by many geologists in an attenuated form.

After the publication of the "Origin of Species" in 1859, showing, in the words of Darwin, that "each species has proceeded from a single birthplace", the distribution of animals and plants became a critical test of the validity of the doctrine of permanency. Edward Forbes had challenged the idea, but Darwin

considered that, when he wrote in 1859, we knew very little about the strange accidents by which living beings secured transport over oceanic barriers; and accordingly he, followed by Lyell in 1868, considered that Dana's views could not justifiably be put aside.

W. T. Blandford, however, speaking as president of the Geological Society, twenty years after Huxley, with far more extensive data at his command, demonstrated that the distribution of animals and plants could not be explained without the previous existence of land surfaces across regions now occupied by oceanic deeps. Although Blandford at that time confined himself to arguments based on biogeography, his previous work in India had led him independently to the same conclusion regarding the southern oceans. It was Blandford who discovered in 1856 the glacial beds at the base of the Gondwana system of 'continental' rocks in India. Later work in the southern continents led to similar discoveries, and ultimately established a correlation between India, Australia, Africa and South America.

So long ago as 1879, Blandford pointed out, in the official "Manual of the Geology of India", that the fossil plants and land animals of the Gondwana system in India were related so definitely to those on the southern continents that land connexions must have existed at certain times, if not continuously, between these areas across the positions now occupied by the

\* Summary of the Huxley Memorial Lecture delivered by Sir Thomas Holland, K.C.S.I., F.R.S., on May 4.

Indian and South Atlantic Oceans. This was well before Eduard Suess gave the name Gondwanaland to the supposed pre-Tertiary southern continent.

Work by C. Schuchert published in 1932 on the distribution of Tertiary fossils confirmed the conclusions established by Blandford from living forms. Schuchert similarly required land communications over some of the present oceanic areas, but demanded relatively small land bridges, thinking, as he said, that it would be "easier to sink smaller continental-like masses than larger ones".

Another, wholly different, explanation for the distribution of life has been elaborated in the last twenty-seven years, mainly by the late Alfred Wegener, who maintained that an ancient continental mass, which he named Pangaea, existed in the South Atlantic and Antarctic region and broke up during the Mesozoic period; that fragments of it drifted away to form most of South America, South and Central Africa, Madagascar, India and Australasia, taking with them their records of geological activities during Palaeozoic times. This theory is thus assumed to account for the glaciation of lands like India which are in the northern tropics, as well as continents which are still south of the equator; it explains, too, the correspondences between the Gondwana rocks of India and those on the southern continents.

Wegener's hypothesis, according to many geologists, is based on insufficient and often discordant data, whilst mathematicians assert that the mechanics involved in these horizontal movements of continental masses are quite impossible.

Following a suggestion made by R. H. Rastall in 1929, it is now urged that discussion of the purely theoretical implications of this hypothesis should await the accumulation of geological data by work on the lines undertaken by A. L. du Toit in comparing Africa and South America. Du Toit has demonstrated the remarkable duplication of geological features between these two areas, from Lower Palaeozoic, age by age, to Upper Mesozoic times. He has also noticed that when the formations vary in the usual way laterally, the variation eastward in Africa and westward in South America is generally greater than that between the corresponding formations on the opposed present shores, although these are now separated by the width of the South Atlantic. Du Toit reasonably concludes that the agreements are too frequently concordant to be regarded as fortuitous, and that the only explanation which best fits the facts is the assumption that these two continents were at one time near one another if they were not actually confluent continental masses.

If it be true that these continental masses have moved horizontally in late geological times away from one another, there is no reason why others should not have done so too, in spite of the circumstance that no completely satisfactory explanation of the mechanics involved can be offered at present. Further work on the lines so ably undertaken by du Toit is now more necessary than mathematical criticism with insufficient quantitative data regarding the physical state of the earth's sub-crust under the continents and oceans.

## Magnetic and Optical Properties of Crystals

UNDER this title, Prof. K. S. Krishnan of the Indian Association for the Cultivation of Science (Calcutta) delivered three lectures in the Cavendish Laboratory, Cambridge, on April 26, 29 and 30. In the first lecture he dealt with recent studies of the diamagnetic properties of single crystals, particularly aromatic compounds. The method of deriving the principal susceptibilities of aromatic molecules by combining magnetic measurements with crystal structure determination was described and also the way in which molecular orientation may be predicted on the basis of magnetic measurements alone. A summary of Pauling's method of calculating the principal susceptibilities of any aromatic molecule was given. The experimental method for measuring anisotropy in magnetic susceptibility was demonstrated and also the remarkable property of graphite crystals both as they occur naturally and after exposure to potassium vapour or to oxidizing agents.

The second lecture was devoted to the recent work on paramagnetic crystals. Prof. Krishnan's study of the magnetic properties of  $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$  has confirmed the predictions concerning the ionic environment made on the basis of theoretical studies and has afforded a remarkable correlation of the magnetic properties with the details of the crystal structure. The influence of the co-ordination on the magnetic anisotropy of the cobalt ion is shown by the comparison of the susceptibilities of  $\text{CoSO}_4 \cdot \text{K}_2\text{SO}_4 \cdot 6\text{H}_2\text{O}$  with those of  $\text{Cs}_2[\text{CoCl}_4]\text{Cl}$ . The former salt, in which the paramagnetic ion is six co-ordinated, is

of great magnetic anisotropy, while the second salt, in which the cobalt is four co-ordinated, has a very small magnetic anisotropy. This result also confirms predictions made on the basis of other physical data. The study of very small magnetic anisotropy of certain manganese salts has made possible the prediction of the entropy of these substances at temperatures near to absolute zero—an important quantity in view of the use to which these salts are put in obtaining very low temperatures by adiabatic magnetization.

The third lecture dealt with the absorption and fluorescent spectra of certain aromatic compounds. Anthracene, naphthacene and chrysene have well-marked pleochroic characters. The absorption spectrum in the ultra-violet region has strong bands for rays vibrating in that principal plane which is most nearly parallel to the plane of the molecules, and weak bands for rays vibrating in that principal plane which is most nearly perpendicular to the planes of the molecules. Naphthacene is a common impurity in anthracene and chrysene, and even when only a few parts per million of the impurity are present a strong fluorescent spectrum is observed. This has the remarkable property of being strongly excited in one plane only, no matter what the relative orientation of the plane of vibration of the incident light. This plane, corresponding to the vibration of the strongly excited spectrum, is coincident with that principal plane which is most nearly parallel to the molecular planes. Some experiments on the photo-dissociation of potassium nitrate in ultra-violet light were also described.