

that little of the synthesis suggested by the title was achieved, many of the papers being presented as isolated units which made no gestures of recognition to their context; and when human *thought* was nominally the subject, it was, perhaps, too often only human *logic* which was discussed. Undoubtedly, however, in the informal contacts which were established, as well as in the formal exchange of information, a valuable preparatory contribution has been made towards a deeper analysis of the processes mediating human thought. D. M. MACKAY

CO-ORDINATION CHEMISTRY

A SYMPOSIUM on co-ordination chemistry, at which there was an attendance of forty, was held at the Butterwick Research Laboratories of Imperial Chemical Industries, Ltd., at Welwyn during September 21–22, 1950. The chairmen were Dr. J. Chatt (first day) and Dr. F. G. Mann (second day). The programme for the first day was concluded by a dinner and social evening, which provided an opportunity for an informal exchange of views. The guests were welcomed by Mr. M. T. Sampson, and Prof. N. V. Sidgwick opened the symposium with an account of the history of the subject up to about 1925.

Dr. F. G. Mann (Cambridge) discussed the complex derivatives of the tertiary phosphines and arsines with mercury and cadmium halides. The mercury complexes fall into five classes: (1) $[(R_3As)_2HgX_2]$; (2) $[(R_3As)_2(HgX_2)_2]$; (3) $[(R_3As)_2(HgX_2)_3]$; (4) $[(R_3As)_2(HgX_2)_4]$; (5) $[(R_3As)_3(HgX_2)_2]$. Cadmium also forms compounds similar to those in classes (1), (2) and (5). The structures of (4) and (5) are unknown. (1) has undoubtedly a simple tetrahedral structure and (2) the bridged structure. Certain compounds of class (3) occur in white and yellow forms. X-ray examination of the white form suggests that it consists of molecules of class (2) alternating with simple HgX_2 molecules, the complete arrangement providing a centre of symmetry. The yellow form has no centre of symmetry.

Prof. G. Schwarzenbach (Zurich) followed with a paper on the stability constants of chelate complexes in aqueous solutions. Bjerrum has shown that simple ligands are added on to metal ions one at a time with gradual falling-off in strength of attachment with each addition. The donor groups of a polydentate ligand are attached simultaneously; if several polydentate ligands are attached, each is much less strongly bound than the last. Prof. Schwarzenbach demonstrated that this simplifies the calculation of the equilibrium constants. It was shown that the geometry of the organic polydentate ligand and the stereochemistry of the metal ion affect the stability of the complex compound. These considerations render it probable that ligands capable of strong binding to any metal cation can be synthesized.

The stability of co-ordination compounds and the varying strengths of metal–ligand bonds was also discussed by Dr. H. Irving (Oxford). In the attachment of ethylenediamine to cobalt, nickel, copper and zinc, the entropy changes are relatively small, and if this is generally true the equilibrium constant for the successive stages in the formation of co-ordination compounds will serve as a measure of relative bond-strengths. The general order of

stabilities of the divalent transition ion complexes was shown to be as follows:



Departures from this order are probably due to steric factors or a change in the bond orbitals used in bond formation.

Dr. R. S. Nyholm (University College, London) described the complexes of iron, cobalt, nickel and copper with *o*-phenylenebis(dimethylarsine) (=D), an exceptionally strong chelating agent. Magnetic susceptibilities of these complexes showed that the metal–ligand bonds are covalent. Univalent copper gives tetrahedral complexes $[CuD_2]X$ and $[CuD_2][CuX_2]$; bivalent iron, octahedral $[FeD_2X_2]$; and bivalent cobalt and nickel, planar $[NiD_2]X_2$ and $[CoD_2]X_2$. Octahedral trivalent complexes of iron, cobalt and nickel were also described, for example, $[FeD_2X_2]X^-$.

In discussing the co-ordination of olefins to platinum salts, Dr. J. Chatt (Butterwick Research Laboratories) briefly explained why he considered none of the structures previously proposed to be satisfactory. Evidence was presented that olefin complex formation probably involves a filled *d*-orbital of the metal atom in the manner suggested by Pauling for the carbonyls. For this bonding the ligand must have both a lone pair for donation to the metal (forming a σ -bond) and a vacant orbital to receive electrons from a *d*-orbital of the metal (forming a π -bond). Ethylene fits into this scheme if its complexes are ethylidene complexes, for example, $K[CH_3CH=PtCl_3]$, and the known reactions of olefin platinum complexes were explained in terms of this structure.

Dr. R. G. Wilkins (Butterwick Research Laboratories) described his experiments to determine the position of equilibrium between *cis*- and *trans*- $((n-C_3H_7)_3M)_2PtCl_2$ ($M=P, As$ and Sb). The course of the isomerization was followed by measuring the change in dielectric constant of their benzene solutions. Whereas the arsenic and antimony complexes isomerize spontaneously, it was found that the equilibrium is labile in the phosphorus series only in the presence of a trace of added $(n-C_3H_7)_3P$. Evidence was presented that the former complexes produced the catalyst $(n-C_3H_7)_3M$ by their own dissociation. Preliminary experiments indicated values of $K = [trans]/[cis]$ at 25° C. to be 30 ($M=P$), 55 ($M=As$) and 3.5 ($M=Sb$).

Some new five-covalent complexes of nickel and cobalt, $[NiBr_3(PEt_3)_2]$ and $[CoCl_2(PEt_3)_2]$, were described by Prof. K. A. Jensen (Copenhagen), who demonstrated the striking colour change which occurs when red $[NiBr_3(PEt_3)_2]$ is brominated to dark green $[NiBr_3(PEt_3)_2]$. Their magnetic susceptibilities and dipole moments indicate that they have the configuration of a square pyramid with the metal atom in the centre of the base, a halogen atom at the apex and the remaining groups at the corners of the base in *trans* configuration. Prof. Jensen has also found an unstable complex of trivalent nickel with dimethylglyoxime (DH_2), this being $Ni(DH)_2Br_3$, which by analogy with the above complex is assumed to have a Br_3 group attached to one side of the square $Ni(DH)_2$ complex.

In discussing the significance of *d*-orbital hybridization in co-ordination compounds from the point of view of quantum mechanics, L. E. Orgel (Oxford) showed that no accurate treatment is at present possible, but that the use of the overlap integral

$s = \int \psi_A \psi_B d\tau$ provides useful qualitative information.

He stressed that overlap calculations suggest that Pauling's bond-strength values over-emphasize the difference between tetrahedral and octahedral bonds. His own calculations are consistent with bonding between the d_{π} -orbital of a central atom and the p_{π} - or d_{π} -orbitals of an attached group, and d_{π} - p_{π} hybridizations may be important in some compounds. If two d_{π} -bonds are formed by the central atom of a square complex, then, other things being equal, the *cis*-configuration will be more stable.

Dr. A. F. Wells (Imperial Chemical Industries (Dyestuffs), Ltd., Manchester) discussed the stereochemistry of atoms in crystals and distortion from ideal 'bond angles' by the geometrical requirements of the attached groups. He illustrated these points by reference to the crystal structures of divalent compounds of palladium, platinum and copper. Copper behaves uniquely and its compounds are not isomorphous with those of any other metal, owing to the peculiar co-ordination of copper which gives it four nearest neighbours at the corners of a square and two more distant neighbours completing a distorted octahedron.

Dr. L. E. Sutton (Oxford), in summing up, welcomed the introduction of physical methods into co-ordination chemistry. The following also contributed to the discussion: Prof. A. Albert (National University of Australia), Dr. J. S. Anderson (Atomic Energy Research Establishment, Harwell), D. C. Bradley (Birkbeck College, London), F. Burstall (Chemical Research Laboratory, Teddington), G. E. Coates (Bristol), Dr. D. P. Craig (University College, London), Dr. D. D. Eley (Bristol), Dr. M. E. Foss (Guy's Hospital, London), Dr. P. George (Cambridge), Dr. A. Maccoll (University College, London), Dr. W. G. Palmer (Cambridge), and Prof. W. Wardlaw (Birkbeck College, London).

R. G. WILKINS

FUNCTIONS OF THE NATURE CONSERVANCY

THE Committee of the Privy Council for Agricultural Research and Nature Conservation has issued a paper*, giving a short account in general terms of the functions and aims of the Nature Conservancy, to meet a demand for information about this body. A separate note dealing more particularly with the recruitment of staff and the award of maintenance allowances is available for *bona fide* inquirers. The present paper points out that the first two functions of the Conservancy, to provide scientific advice on the conservation and control of the natural flora and fauna of Great Britain, and to establish, maintain and manage Nature reserves, cannot be carried on without continuous scientific research to build up and maintain the essential body of knowledge and experience. This research will be conducted principally, but not exclusively, in the proposed Nature reserves, and the Conservancy can make grants in aid of specified researches to be undertaken by the universities or other research bodies and award maintenance allowances for the postgraduate training of suitable students. As a start, provisional laboratory accommodation is being attached to the

* Committee of the Privy Council for Agricultural Research and Nature Conservation. The Nature Conservancy. Pp. ii+6. (Nature Conservancy, 91 Victoria Street, London, S.W.1. 1950.)

Conservancy headquarters in London and Edinburgh, and the establishment of a fully equipped terrestrial research institute is under consideration.

The Conservancy has provisionally scheduled about a hundred and fifty places in Great Britain as National Nature Reserves. Of these, seventy to eighty in England and Wales and about thirty in Scotland are areas of biological or physiographical importance, while some forty are features of special geological importance and will be administered in the same way. When the areas finally selected have been accurately surveyed and delimited and either acquired or made subject to suitable management agreements, they will be declared National Nature Reserves under the Act. The Conservancy may also make by-laws for the protection of a National Nature Reserve, by controlling entry into, or movement within, a Reserve, the killing or taking of animals of any description, or interference with the vegetation and soil, and the lighting of fires, etc., and it may also control the killing of birds within surrounding areas; this last provision is necessary to avoid serious effects on the bird population of a reserve. Restriction of entry will only be applied where and when it is essential to serve the purposes for which the reserve was established. It is imperative that most of the reserves should be actively managed, and the Conservancy intends to train a staff to take charge of the reserves, to study continuously the effects of different kinds of treatment, to arrange for the destruction of pests, and to keep the plant and animal populations in balance. Some of the more important reserves will each have a resident officer who will participate in the necessary research as well as be responsible for day-to-day management. In others a single officer may be able to look after a group of reserves. Provision is also made for local Nature reserves to be established by local authorities in agreement with the Conservancy.

It is recognized further that Nature reserves alone cannot sufficiently provide for the general conservation of the flora and fauna, for comparative studies, or for the display of particular types of plant and animal communities on an adequate scale. The Conservancy is required to notify the local authorities concerned, or the agricultural departments and the Forestry Commission, of any other places of special scientific interest. The Conservancy cannot here, however, do more than seek to persuade the responsible authorities of the importance of scientific interests and to encourage general conservation of the flora and fauna and features of special geological importance by all concerned over much wider areas in which scientific interests, though important, cannot be paramount.

Finally, the paper seeks to make clear the distinction between the functions of National Parks and of National Nature Reserves, and in particular that while, so far as land is concerned, the first objective of the Nature Conservancy is the preservation as Nature reserves of good samples of the various types of natural and semi-natural vegetation with their accompanying animals, as well as the stations of rare and interesting species, the principal objective of reservation is scientific study. The Conservancy is convinced that properly organized study and research, carried on mainly in the reserves, is essential both for the increase of fundamental knowledge and for the future application of this to the proper management of National Parks and to the development of similar land for other uses.