

every given pair of atoms; in this approximate sense, interatomic distances in simple crystalline structures are in agreement with the supposition that they obey an additive law and that the dimensions of the domain are proportional to those of the atomic structures in a series such as has been given above. I directed attention to this additive law as an empirical fact in the discourse referred to above, but made the domain of the positive ions too large and those of the negative ions too small. A better interpretation of the significance of the law was given by Wasastjerna in a paper on the "Radii of Ions" in which due weight was given to the relative dimensions of the electronic structures. Recently, Jones, in a series of highly interesting papers, has linked up the fields which give the repulsion between atoms of an inert gas, and the fields of the corresponding ionic structures in crystals.

Again, in the case of the very simple crystals, good quantitative agreement between calculation and observation of crystal dimensions can be obtained by certain simple assumptions about the nature of the repulsive field due to their electronic structures. In the more complex crystals the concept of an atomic domain is by itself sufficient to explain the general configuration of the crystal. Cases which are especially interesting are those where the domain of one ion is much larger than that of the other. The structure of aluminium oxide, Al_2O_3 , is an example. Since the oxygen ion is so much larger than the aluminium ion, the structure is that of a series of oxygens in a close-packed arrangement (hexagonal) with aluminium atoms in the interstices acting as a cement to bind the whole together. In spinel, MgAl_2O_4 , the oxygen atoms are in a cubic close-packed arrangement. In cadmium iodide, CdI_2 , the large iodine atoms are in hexagonal close-packing with cadmium atoms lying between alternate layers perpendicular to the hexagonal axis. Tin tetraiodide is another case where a quite complex structure approximates closely to a cubic close-packed arrangement of iodine atoms. Such crystals give a great deal of information about the forces between atom and atom.

In a few cases it has been possible to determine the shape of the acid radical. In CO_3^{--} and NO_3^- the oxygen atoms are arranged at the corners of an equilateral triangle around the central atom, and the arrangement must be very nearly the same in ClO_3^- . Though we do not know the arrangement of the oxygen atoms round the sulphur atom in SO_4^{--} with such certainty, they must be nearly at the corners of a

regular tetrahedron, and the arrangement also holds in such groups as ClO_4^- , MnO_4^- , SeO_4^{--} . In an ion such as PtCl_6^{--} Wyckoff has shown that the six chlorine atoms are arranged at the corners of a regular octahedron around the platinum atom. The simple geometrical shape in each case is interesting, and it is difficult to avoid the conclusion that the outer atoms are all related in the same way to the inner one. Kossel regards the inner atom as having a large positive charge, and holding the negatively charged outer atom by electrostatic attraction. Although the actual bonds may be of a more complex type, it is interesting to see how much this idea explains. The dimensions of the group are in accord with the idea that the large oxygen ions are grouped around a relatively small atomic structure with a high positive charge in the centre, and that the size of the group is mainly determined by the repulsive forces between the oxygens. Certain optical properties can be explained by the same conception. The refractivity of the acid group is got by assigning a value of about 3.3 to the ionic refractivity of each oxygen, and a very small value to the central atom. The strong negative double refraction of carbonates and nitrates, where the groups of oxygen atoms lie in parallel planes, is explained quantitatively by the influence on each other of the oxygen atoms arranged in a triangle. On the other hand, most sulphates have a very small birefringence. This may be explained by the regular tetrahedral arrangement of oxygens around the sulphur, for such a group on account of its symmetry is optically isotropic.

The problem of the other type of binding between atoms, in which the electronic structures seem to fuse together so that the atoms approach each other closely and are rigidly connected, has yet to be solved. In acid groups such as CO_3^{--} and SO_4^{--} the atoms may retain separate electronic systems, or the other type of binding may have come into play. In any case the atoms must be greatly distorted by their unsymmetrical location. X-rays can only tell the positions of the atomic centres, the skeleton of the structure, since the interference between waves scattered by the electrons is so complex. The centres can be fixed with considerable certainty, however, and cases of undoubted homopolar combination can be examined. The interest of the inorganic structures lies principally in the fact that they can be analysed with some degree of completeness, and it is to be hoped that they will tell more about the binding forces. They present a fascinating series of problems for solution.

Southampton Meeting of the British Association.

LOCAL ARRANGEMENTS.—II.

VISITING members of the British Association are requested to book for Southampton West Station, where men wearing distinctive armllets will be in attendance on the station platforms to render assistance to members on arrival and to afford information. The idea of a special train from Waterloo on the Tuesday, the day before the opening of the meeting (as previously announced), has been dropped because the existing means of communication to Southampton, on further examination, were found to be amply sufficient. Baggage may be deposited at

the Reception Room if desired for conveyance to the address in Southampton where the member will be staying. Tickets of membership may be obtained at the Reception Room.

The Reception Room is at King Edward VI. Grammar School in the Marlands, two minutes' walk from the West Station. Here the following facilities will be provided for members: ticket and information bureau, where a representative of the Southern Railway will be in attendance; telephones; smoking and writing room; ladies' rest rooms; post office;

exchange of communications between members; cloak room; press bureau; bookstall; administrative rooms, etc.

The official restaurant for the meeting will be the Coliseum, situated in Portland Terrace, three minutes' walk from the Reception Room. Special arrangements have been made with Messrs. Price Bros., caterers, for the convenience and advantage of the members. Luncheons and teas will be available. For the convenience also of members of the sections meeting at the University College, Highfield, the College refectory will be open for lunches and teas.

Rest rooms for ladies have been very kindly provided at each of the following houses: (1) Y.W.C.A. in Portland Terrace; (2) The "Barova Restaurant," at Messrs. Tyrrell and Green, Ltd., Above Bar Street near the junction; (3) Messrs. E. Mayes and Son, Ltd., 173-178 High Street, below the Bargate; (4) The Central Hall, at the bottom of East Street. Accommodation for both ladies and gentlemen will also be available at the Central Hall. An excellent and well-illustrated booklet, "Southampton and the New Forest," compiled by Messrs. Russell and Co., will be presented to each member. Therein on p. 5 will be found a street map of Southampton, and likewise on p. 75 a full list of places of worship.

Badges, which members are particularly requested to wear on all occasions, will be handed them at the Reception Room, and will prove most valuable for identification of membership. The Corporation Tramways Committee has generously decided to extend the privilege of free use of the tramcars and omnibuses of the municipality to members during the period of the meeting.

The Royal Southampton Yacht Club, the Constitutional Club, and the Portswood Conservative Club have kindly offered honorary membership during the week to all members of the Association; while the Rotary Club of Southampton invites all visiting Rotarians to the luncheon on the Friday in the South-Western Hotel, and the Masonic Lodges of the town have offered to their brethren in freemasonry and their ladies a reception at the Chantry Hall on the Monday, when afternoon tea will be served. A civic reception will be given by His Worship the Mayor and the Mayoress of Southampton at the Pavilion, Royal Pier, on Thursday evening at 8 o'clock, and it is hoped that members will make a point of attending this function. A reception will be given by Lord and Lady Swaythling at their mansion, Townhill Park, on Sunday, August 30, at 8 P.M., when a special omnibus service will be run in connexion with the event. Garden parties will be given by Lord and Lady St. Cyres at Walhampton near Lymington on Friday, August 28, at 3 P.M., and on the same afternoon by Sir John and Lady Power at Newlands Manor near Lymington, New Forest.

The Cunard Co. has very generously invited the British Association to visit the R.M.S. *Aquitania*, and have tea on board on Friday, August 28; the White Star Line has extended a similar invitation, to the R.M.S. *Majestic*, on Monday, August 31; while Commander C. B. Fry has thrown open for inspection the Training Ship *Mercury* on the Hamble River on Saturday, August 29, at 3.30 P.M.

Invitations for parties from the British Association to see over their works have been received from the following firms: The International Cold Storage and Ice Co., Ltd., the Docks; Pirelli General Cable Works, Ltd.; Auguste Pellerin, Ltd. ("Le Dansk" Margarine Factory); The Southern Railway Co. for the Docks; Messrs. Harland and Wolff, shipbuilders, the Docks; The Ordnance Survey Office, The Avenue; Messrs. Toogood and Sons, seedsmen.

Two organ recitals have been arranged to be given in the New Central Hall: (1) a grand organ recital on the Saturday, August 29, at 7.45 P.M. (admission 6d.), when a large number of seats will be specially reserved for members of the Association; (2) a special organ recital on the Sunday afternoon, August 30 (admission free), from 3 to 4.15 P.M. This performance will be broadcasted by the British Broadcasting Co. and all members of the British Association are heartily invited.

General excursions have been arranged as follows:—

Thursday, August 27.—Messrs. Toogood and Sons, Ltd., Seed Warehouse, "Blighmount," Millbrook, at 3 P.M.; Pirelli, Ltd., Cable and Tyre Works, Western Esplanade, at 2.30 P.M.

Friday, August 28.—The s.s. *Aquitania*: invitation from the Cunard Co. to inspect the vessel and have tea on board, 3 to 5 P.M.; New Forest trip, including garden party, by Lord and Lady St. Cyres, at Walhampton, near Lymington, at 3 P.M. (on the return journey, Beaulieu Abbey and House will be visited by invitation from Lord and Lady Montagu); New Forest trip, including garden party, by Sir John and Lady Power, at Newlands Manor, Lymington, at 3 P.M.; Ordnance Survey Office, The Avenue, Southampton, 2 to 4 P.M.

Saturday, August 29.—Isle of Wight (whole day): by steamer to Cowes then motor via Newport, Sandown, Ventnor, where lunch will be served, Alum Bay, Carisbrooke, where tea will be had, and back to Cowes; Stonehenge (whole day): via Romsey and Salisbury, returning by Winchester; T.S. *Mercury* on the Hamble River by steamer (leaving at 2.30 P.M.) down Southampton Water; Winchester: leaving at 2.30 P.M., half day excursion.

Sunday, August 30.—Reception at Townhill Park by Lord and Lady Swaythling at 8 P.M.

Monday, August 31.—The s.s. *Majestic*: invitation from the White Star Line to inspect the vessel and have tea on board, 3 to 5 P.M.; Auguste Pellerin, Ltd., "Le Dansk" Margarine Factory, Northam, at 2.30 P.M.; Southampton Gaslight Co., Ltd., tea at 3.30 P.M. at the works; Ordnance Survey Office, The Avenue, Southampton, 2 to 4 P.M.

Tuesday, September 1.—General visit to Southampton Docks at 2.30 P.M.; Messrs. Harland and Wolff's Ship Repairing Works, the Docks, at 2.30 P.M.; the International Cold Storage Co., Ltd., the Docks, at 3.30 P.M.; Goughs Ice Co., Ltd., Canute Road, Southampton, at 5 P.M.; Ordnance Survey Office, The Avenue, Southampton, 2 to 4 P.M.

The following sectional excursions have been arranged:

Thursday, August 27.—K, Hythe and Beaulieu; G, Southampton Docks; K (Forestry Subsection), Messrs. Howard Bros. Timber Yard, Northam; C, The Ordnance Survey Office, The Avenue, Southampton.

Friday, August 28.—L, South Stoneham House, (garden party); E, Portsdown Anticline; G, Southampton Waterworks at Otterbourne; C, Bournemouth.

Saturday, August 29.—C, Isle of Wight (whole day); D, Beaulieu via Southampton Water and the Solent (whole day); K, Meon Valley and Portsdown (whole day); H, Salisbury and Stonehenge (whole day); M, Sparsholt Farm Institute (whole day).

Sunday, August 30.—C, Lulworth Cove (whole day); K, New Forest (whole day); L, Winchester.

Monday, August 31.—D, Hayling Island; E, Northern Part of the New Forest; G, Calshot Aerodromes and the Agwi Petrol Works at Fawley; I, Antigas School at Tipnor; K (Forestry Subsection), Durlay Saw Mills (Messrs. F. Houghton, Ltd.); B, Holton Heath Cordite Factory.

Tuesday, September 1.—D, New Forest; G, Railway Works at Eastleigh; G, Supermarine Aviation Works, Southampton; G, Avro Works at the Hamble; K, Hurst Castle; M, Fruit Farm, Botley; I, Fort Grange Aerodrome, Gosport; C, Hordle and Barton.

The evening discourse will be given by Mr. R. V.

Southwell on "Aeronautical Problems of the Past and of the Future," at 8 P.M., in the Central Hall, on Friday, August 28. Citizens' lectures have been arranged as follows:

(1) Major A. G. Church, on Thursday at 7.30 P.M., on "Science and the East African Commission" at the Central Hall; (2) Prof. E. V. Appleton, on Saturday at 8 P.M. at the Avenue Hall, on "The Rôle of the Atmosphere in Wireless Telegraphy"; (3) Capt. P. P. Eckersley, on Monday at 8 P.M. at the Central Hall, on "Some Technical Problems of Broadcasting"; (4) Mr. C. J. P. Cave, on Tuesday at 8 P.M. at the Central Hall, on "The Highway of the Air."

Lectures for Young People at the Central Hall are arranged as under:

(1) Dr. F. A. Dixey, on Saturday at 3 P.M., on "Mimicry in Relation to Geographical Distribution"; (2) Mr. W. H. Barker, on Monday at 3 P.M., on "The Development of Southampton in Relation to World Commerce"; (3) Prof. W. J. Dakin, on Tuesday at 3 P.M., on "Whaling in the Southern Ocean."

W. RAE SHERRIFFS.

Current Topics and Events.

PROF. J. G. MCKENDRICK, F.R.S., the distinguished emeritus professor of physiology in the University of Glasgow, reached the age of eighty-four years on August 12; Sir William Tilden, F.R.S., eminent as a chemist, celebrates his eighty-third birthday on August 15. The former was born at Aberdeen and educated there at the University. For thirty years he was professor of physiology in the University of Glasgow; he was sometime Fullerian professor of physiology at the Royal Institution and president of Section I (Physiology) of the British Association. At the Oxford meeting, in 1894, of the British Association, he exhibited and demonstrated a working model intended to illustrate the mechanism of the cochlea. With Dewar and Ramsay he conducted researches on the physiological action of the chinoline and pyridine bases. Sir William Tilden, a Londoner, was a science master at Clifton College, 1872-80, leaving to take up the chair of chemistry at Mason College, Birmingham, a post which he held for fourteen years. On leaving Birmingham he became professor of chemistry at the Royal College of Science, London, retiring in 1909. He was awarded the Davy medal of the Royal Society in 1908. In organic chemistry he has made highly important researches on the terpenes, for example, on the hydrocarbons from *Pinus sylvestris*, and on terpin and terpinol. Author of many scientific memoirs, he has also published several well-known chemical manuals.

The report of the Electricity Commissioners in Great Britain for the year 1924-1925, which has just been published, is of considerable interest. In public supply undertakings the output for the year is 7415 million units, which is an increase of about 16 per cent. on the output of the preceding year. In private plants the output would probably be about half as much. The increased output has been obtained at an appreciably higher efficiency. Last year the

average coal rate per unit generated was 2.53 lb. In the two preceding years it was 2.67 and 2.78 lb. respectively. This steady progress is satisfactory but there is plenty of scope for improvement. The new Barton station at Manchester shows the highest efficiency, namely, 1.51 lb. of coal per unit generated, and its thermal efficiency is practically twenty per cent. The coal consumption at the gas producer stations ranges from 1.81 to 3.69 lb. per unit generated, the average being 2.60 lb. per unit. The largest Diesel engine oil-driven station (1940 kilowatts) has a thermal efficiency of 26.6 per cent. For small stations internal combustion engines are the most efficient. Water power only contributes about 0.7 per cent. of the total supply of electricity in Great Britain. Several large plants are now being constructed, but the total possible water power is, unfortunately, small.

THE transmission of photographs by means of telephone circuits has recently been perfected to so great a degree that the picture as received is practically a perfect reproduction of the original and shows no signs of the process of transmission. The principle of the method is well known, namely, two cylinders, one at each end of the circuit, rotating synchronously and moving axially so that a spiral line 0.01 in. wide is made to cover the surface dealt with. The sending cylinder has within it a photo-electric cell; the photograph in the form of a transparency or film is attached to the transparent surface of the cylinder, and a small spot of light falls upon the photograph so that the illumination of the photo-electric cell and the current produced are proportioned by the density of the photograph. The current produced is too feeble for transmission, therefore it is amplified, and then, by means of a vacuum tube modulator, imposed on a high frequency carrier current. At the receiving end the current passes through a narrow flat conductor which covers a small hole and is deflected by the current,