

Research Items.

BACTERIAL CONTENT OF THE ATMOSPHERE OF THE LONDON UNDERGROUND ELECTRIC RAILWAYS.—Previous work on this subject is almost limited to a report by F. W. Andrewes in 1902 on the air of the Central London Railway and to a study by G. A. Soper in 1904 of the air of New York subways. Dr. J. Graham Forbes carried out an investigation in 1920 of the air of six London electric railways (*Journ. of Hygiene*, vol. xxii., 1924, p. 123). The average of all results does not compare unfavourably with the outside air of London. The ratio of the number of organisms which develop at room temperature (about 20° C.) is about 14 for railway air to 10 for outside air, but the ratio for organisms developing at body temperature (37° C.) is considerably higher, namely 2 to 1 respectively. The mean number per litre of air, for room temperature organisms, is about 9 in railway air and 6.3 in outside air; for body temperature organisms, 4.6 in railway air and 2.2 in outside air. Increase or decrease in passenger density in the cars is generally, but not always, associated with a rise or fall in the bacterial content of railway air, affecting both groups of organisms; the actual number of organisms is affected by other factors, such as fluctuating air currents and movements of passengers. The bacterial content of platform air is generally higher than car air, probably on account of the greater amount of draught and dust disturbance. The bacterial content of car air was lowest on the Central London and highest on the City and South London, the latter being about 34 per cent. more than the former. The organisms comprised a number of species of micrococci, bacilli, sarcinæ, yeasts, streptothrices, and moulds. While some of the organisms met with occur in the mouth, nose, and on the surface of the body, in no instances were pathogenic organisms specifically proved to be present, other than certain moulds, e.g. *Aspergillus niger* and *A. fumigatus*.

DIROFILARIA IMMITIS FROM THE CAT.—In a collection of helminths from Dutch Guiana, Dr. R. J. Ortlepp records (*Journ. Helminthology*, vol. ii. pp. 15-40, 1924) a male specimen of *Dirofilaria immitis* from the heart of the domestic cat, and remarks that this appears to be the first record of the species from the cat, the usual host being the dog. The Ascarid *Lagochilascaris minor* is recorded from a mastoid abscess in man.

DIVISION OF THE NUCLEUS IN AMŒBA PROTEUS.—Sister Monica Taylor has utilised her rich culture material to make observations on the division of the nucleus (*Quart. Journ. Micro. Sci.*, vol. 67, pp. 39-46, 1923). The nucleus is discoidal with stout membrane, on the inner surface of which are chromatin blocks, and immersed in the nuclear sap is the plate-like karyosome, consisting of a ground substance and of small blocks which stain like chromatin. Division of the nucleus is effected when the amœbæ have withdrawn their pseudopodia and have become spherical. Each of the chromatin blocks adjacent to the nuclear membrane divides into two; this process begins at one point and gradually extends until all the blocks have so divided. The outer set of daughter products gradually separates from the inner owing to increase of nuclear sap, and the distance between the two sets increases. The karyosome divides into two, each part becoming associated with one of the sets of chromatin blocks, and the nucleus becomes "lobed" and divides into two. The nucleus may undergo rapid successive divisions into four or more. The process is not one of ordinary mitosis. The mitosis

which has been observed by Miss Carter and by Doflein is attributed by the author to the sporulation cycle of the life-history.

EVOLUTION IN THE CILIATE FAMILY OPHRYOSCOLECIDÆ.—Howard Crawley has contributed (*Proc. Acad. Nat. Sci. Philadelphia*, vol. 65, pp. 393-412, 1923) a useful survey of the Ophryoscolecidæ—a family of oligotrichous ciliates most of the species of which live in large numbers either as mutualists or as commensals in the first and second stomachs of ruminants. This family is closely circumscribed and is readily distinguished from all other ciliates, and the author considers it is permissible to conclude that it is of monophyletic origin. These ciliates, developing in an isolated environment under influences which are constant, offer for study a case comparable with the fauna of a region long isolated, e.g. an oceanic island, and hence furnish favourable material for the study of evolution. The five genera—Entodinium, Diplo-dinium, Metadinium, Epidinium, and Ophryoscolex—form a linear series, the first-named being the most primitive. Generic distinctions are based on the form of the ciliary apparatus, specific on the nature of the armature present at the posterior end; these two sets of characters vary independently, "thus bringing about the unusual phenomenon of a change of genus without any change of species."

WINTER STAGE OF THE APPLE SCAB FUNGUS.—The fungus disease known as apple scab, with its tendency to produce black discoloured patches on the fruit, depreciating both market value and keeping qualities, has long been known in England, and it was also known that the so-called summer stage of the disease, in which the fungus resembles the forms placed in the genus *Fusicladium*, was able to persist over the winter beneath the bark of the apple shoot. E. S. Salmon and W. M. Ware now record in the *Gardener's Chronicle* for April 5 the true ascigerous stage of this fungus. The perithecia were obtained upon leaves collected in a Kentish orchard in February last; the authors state that examination of them has convinced them that the apple scab fungus is identical with the fungus described by American authors as *Venturia inaequalis*. They also report that they have found *Venturia pirina*, the winter stage of the pear scab fungus, in England.

"SLIME-FLUXES" OF TREES.—This somewhat unusual subject has been reported upon by Mr. Lawrence Ogilvie in the Transactions of the British Mycological Society, vol. 9, part iii., as the result of experiments and observations carried out at Cambridge under the guidance of Mr. F. T. Brooks. Two types of such "fluxes" are distinguished, the brown (including a red variety) considered by the author to have their origin in the exudation from the heart wood of the tree of a fairly clear liquid, which escapes through the bark either at an injury or through a natural crack in the bark. Mr. Ogilvie associates this exudation with the curious water-soaked region of the wood, recently described by Prof. W. G. Craib in his experiments at Aberdeen, which alters in distribution in the wood with the season (*NATURE*, July 7, 1923, p. 21). The fluxes themselves are active practically all the year round, and the author states that "practically all stages have been traced between the water-soaked areas and the typical flux." The other type of flux, the white flux, noticed mainly on willows at Cambridge, appears to be an exudation from the pith. In both fluxes a characteristic fungus, bacterial and yeast flora, develops, which is mainly

responsible for the colour of the flux, but this flora seems to be in no sense causative in the production of the flux.

CLOUD AND SUNSHINE IN NETHERLAND INDIES.—In Verh. No. 8, vol. 1, part 4, the Royal Magnetic and Meteorological Observatory of Batavia publishes, under the superintendence of Dr. C. Braak, a brief English summary of this topic, as well as a full discussion in Dutch. Causes of cloud formation are dealt with, and the daily variation of various cloud forms. Good photographic illustrations are given of the different cloud forms and cloud-caps. A typical cloud feature in the tropics is the marked diurnal variation of cloud formation. It surpasses the non-period variations and in many cases also the seasonal differences. Heavy clouds at night are quite common at Batavia in the west monsoon, and most of the rain falls at night. Cloudiness as a climatological factor is said to be much more important for the mountains than for the plains. The heaviest rainstorms do not usually reach the mountain top, but drift away to the plains after having originated on the mountain slope, and thunder is seldom heard on the top at a close range, but often at some distance above the slopes. In daytime the ascending air movement gives rise to the formation of cumulus clouds above the land, and it operates in the same way at night over the sea. Above the coast plain the height of the cumulus base is given as between 700 and 1000 metres. On the mountain slopes the first cumuli originate at a greater height, but on the exposed mountain sides the cloud base sinks much lower during a strong wind in the wet season. For the sunshine records Jordan's twin pattern recorder is generally used; thus differing from the usual sunshine recorder used in the British Isles. The whole discussion affords much material for scientific consideration.

CLIMATIC CONTINENTALITY AND OCEANITY.—In a paper read before the Royal Geographical Society on April 14, Mr. D. Brunt discussed critically Spitaler's recent work on this subject. Spitaler gave the formula $t_{\phi} = (A + BS_0 + CS)(1 - n) + (D + ES_0 + FS)n$ as an empirical relation connecting t_{ϕ} , the mean monthly temperature at sea-level for the whole of the parallel of latitude ϕ , with n , the "continentality" of the latitude, defined as the fraction of the zone between latitudes $(\phi - 1)^{\circ}$ and $(\phi + 1)^{\circ}$ which is covered by land—and with S and S_0 . The latter are respectively the monthly and annual mean intensities of solar radiation for the latitude, during the time when the sun is above the horizon, no allowance being made for albedo or for absorption in the earth's atmosphere. It appeared that E was small, and it was therefore set equal to zero. On this basis, if n is put equal to 1, corresponding to a parallel of latitude covered wholly by land, t_{ϕ} should depend only on S , the radiation for the month in question, and not at all on S_0 ; this agrees with our preconceived ideas as to the quick response of land to the immediate thermal influences acting on it, and its independence of more remote influences; if, however, we put $n = 0$, t_{ϕ} depends both on S and S_0 , in accordance with the power of the sea to retain heat over a long period. The constants A , B , C , D , and F , the same for all latitudes and months, were determined from the mean values of t_{ϕ} at 25 latitudes at 5° intervals, for January, July, and the annual mean; the resulting formula well represents the observed values of t_{ϕ} . Spitaler next proceeded to base on this formula a definition of the continentality n_c of a single station; the values of t_{ϕ} and S for the station, for January

and July, were inserted in the formula, S_0 was eliminated, and the value (n_c) of the quantity n was determined. When thus used, the formula has the form $n_c = G + H(t_{\phi} - t'_{\phi})/(S' - S'')$, where G and H depend on C and F , while the single and double accents refer respectively to January and July. Charts giving iso-continental lines, or lines of equal n_c , were drawn; regions for which n_c exceeds one-half were termed continental, and the remainder were termed oceanic. The dividing line $n_c = \frac{1}{2}$ occurs some distance inland, where the prevailing wind blows from the sea. These charts are worthy of close study by those interested in climatology.

THE LOCATION OF EARTHQUAKE EPICENTRES.—Dr. S. W. Visser's latest paper (*Natuurkundig Tijdschrift voor Ned.-Indie*, 1923, pp. 133-153) is mainly a criticism of the methods used by the British Association Seismological Committee and the Dominion Observatory of Ottawa for locating distant earthquake epicentres. The author holds that the epicentres in each district should be determined by local seismologists, and claims that his results for the East Indies do not err by more than 0.3° from the correct position. Assuming his own determinations to be accurate, he finds the error in the British Association estimates for fifty earthquakes (1913-16) to range from 10 to 1520 km., the average difference being 293 km. In like manner, the error of nineteen Ottawa estimates (1916-20) would range from 40 to 770 km., with an average difference of 318 km. On these results, Dr. Visser comes to the following conclusions: (1) That inferences with regard to the distribution of earthquakes and the connexion with geological structure founded on such estimates are not exact; (2) that Prof. Turner's procedure in calculating the depth of the focus is not allowable when errors of several hundreds of kilometres in the horizontal direction are possible; and (3) that Prof. Turner's estimated seismic period of 21.00155 minutes is not a real one, as the errors in the positions of the epicentres may give discrepancies of nearly four minutes in the time of occurrence.

ELECTRONS IN METALS.—Although various forms of the electron theory of conduction of heat and electricity in metals have been suggested, none of them has succeeded in accounting for the whole of the facts known with regard to conduction by means of a single type of carrier of electricity such as the electron. They all lead to expressions for the Hall effect and for the thermo-electric power of a metal, and comparisons of theory and experiment have not afforded much support for the theory. In the issue of the *Physikalische Zeitschrift* for February 15, Dr. P. Raethjen gives an account of measurements of these quantities for silver, gold, platinum, copper, aluminium, tin, and palladium, undertaken at the suggestion of Prof. Kaufmann with the view of a more complete test of the theories. He finds that the two quantities show no signs of being related to each other in the way that electron theory suggests.

THE SCATTERING OF X-RAYS BY LIGHT ATOMS.—Messrs. W. Friedrich and M. Bender contribute to the *Annalen der Physik* for March an article, in which they describe measurements of the scattering of X-rays by lithium, sodium, potassium, water, and methyl alcohol, and endeavour to trace a connexion between the observed azimuthal distribution of intensity of the scattered radiation and that calculated, in accordance with Debye's views, as due to intra-atomic interference caused by the electrons of the Bohr atoms, with different assumptions as to the exact relations between the orbits. X-rays from platinum

were made use of in the investigation; a tungsten filter being employed of such thickness that only the $K\alpha$ doublet was employed. Sodium and potassium were used in the liquid state, so as to avoid interferences due to the crystalline form; lithium could not be used as a liquid, as in that state it was found to act on the glass containing it. It was shown, however, that the interferences due to the crystal layers did not affect the measurements, so that solid lithium was employed. The observed scattering agrees approximately with that calculated from the electronic structure for lithium, water, and methyl alcohol, but not for sodium and potassium. That the agreement is better for scattering from an element of small atomic number than from elements of higher atomic number is only to be expected, since the possibilities of different electron structure (constellations) are not so numerous in the former as in the latter case. It is proposed to make further experiments with a very narrow beam of X-rays, so as to be able to make measurements for smaller azimuths.

SPECTRAL LINES PRODUCED BY ELECTRON COLLISIONS.—In the *Zeitschrift für Physik* for March 6, Dr. G. Hertz describes measurements of the excitation voltages required to produce different spectral lines in certain gases. The excitation voltage V for any line is given, according to the Bohr theory, by $Ve = J_e - \frac{h}{T}$, where J is the ionisation voltage, and T is the smaller of the two terms characterising the line. The difference between the excitation voltages of two lines is often only a few tenths of a volt, and it is difficult to measure such small quantities. In the usual form of apparatus employed, the different points of the incandescent cathode are at different potentials, so that the velocities of the electrons are not all the same. Dr. Hertz gets over this by using a strip of platinum foil, with a nick at the middle of each edge, as cathode, so that only the narrow portion between the nicks gets hot, and sends out electrons, the potential difference for different electrons being no more than 0.1 volt. A fine meshed grid was employed, which was connected metallically to the parallel anode plate, and disturbances due to space charge in the observation space between grid and anode were kept down by making the current density small, so that 6 to 12 hours were necessary to photograph the spectrum. Photographs are reproduced showing the mercury spectrum at 8.7 and at 9.7 volts; several new lines appearing at the higher voltage; line 3650 is absent in the first, and is much the strongest line in the second; helium at 23.6 and 24.4 volts shows a number of additional lines at the higher voltage, while with neon a series of five photographs, for voltages between 18.5 volts and 20 volts, show the gradual development of the red group of lines of this substance. With zinc, the triplet 4680, 4722, 4811 could be obtained alone, and the strong red line 6362 only appeared when the potential was raised one volt; with thallium the exciting voltage of the green line was found to be 3.5 volts, which confirms the suggestion that the $2p_2$ state of thallium is the normal one, as Grotian found by absorption measurements.

TRANSFORMATION OF DIAMOND.—Messrs. G. Friedel and G. Ribaud describe experiments on the effect of heat on the diamond in *Comptes rendus* of the Paris Academy of Sciences for March 31. Crystals from all sources show black lines, when observed between nicol prisms, which appear to be due to deformations of a substance originally isotropic. Uneven cooling of the original magma in which the crystals were formed, and external mechanical action, are not sufficient to account for the amount of double

refraction observed; and it seems necessary to assume that a polymorphic transformation, accompanied by a change of volume, has taken place at a temperature when the plasticity was sufficient to allow the crystal to retain permanent deformations. Diamonds were heated in an alternating-current furnace, and the temperatures were measured with an optical pyrometer. Conversion into graphite takes place near this interesting point, so that close temperature regulation was needed. From 1500° C. on, the surface began to blacken, only a thin skin being affected. This is translucent, and consists of diamond containing a small proportion of graphite; it is hard and brilliant, is not affected by chemical reagents which oxidise graphite, but is burnt away, leaving colourless diamond, in a bunsen burner. A few minutes at 1800° causes more rapid production of graphite along the edges of the crystal. Up to 1850°-1865° the bands seen between nicols show no alteration when reobserved after cooling; but towards 1875°-1880° they show some deformation in places, indicating a certain plasticity at this temperature. When the temperature $1885 \pm 5^\circ$ is exceeded the crystal breaks into fragments, bounded by octahedral planes of cleavage, and the bands due to double refraction undergo a complete change. It is possible to observe this only if the temperature is exceeded for a few seconds, otherwise the whole of the diamond is very rapidly converted into graphite; it seems probable that above this temperature a new form of crystal is produced, which is converted into graphite more rapidly than ordinary diamond.

CHEMICAL ANALYSIS OF COTTON.—Methods devised by the British Cotton Industry Research Association for the chemical analysis of cotton, and published in the *Journal of the Textile Institute*, vol. xv., No. 3, will prove of general interest both to chemical technologists and to plant physiologists. R. G. Fargher and Lucy Higginbotham describe methods by which saponification, acid, and acetyl values and unsaponifiable matter can each be determined on from 0.1 to 0.2 gm. of material. A. Geake describes a rapid sedimentometric method for the estimation of phosphorus; the volume of a precipitate of strychnine phospho-molybdate is determined under standard conditions, the method being rapid and applicable to small quantities of material. B. P. Ridge describes the micro-Kjeldahl method as found trustworthy for the determination of nitrogen. From the preliminary survey of the field by these methods, Geake and Ridge find that Egyptian cotton contains appreciably more nitrogen and phosphorus than American varieties, whilst short and presumably immature hairs contain more than the longer hairs. P. H. Clifford, Lucy Higginbotham, and R. C. Fargher describe the results obtained in the extraction of raw cotton and sized and bleached goods with various fat solvents; they suggest that extraction with chloroform in a hot Soxhlet should be assumed to extract fat, wax, and resin, whilst carbon tetra-chloride extraction in an ordinary Soxhlet should be regarded as removing fat and wax only. From the same Research Association and in the same *Journal* is an important paper by A. R. Urquhart and A. M. Williams upon the moisture regain by cotton, which gives very definite experimental evidence that there are two possible values of moisture regain, the higher being reached if the cotton had originally been in a moister atmosphere and a lower if it had come from a drier atmosphere. Cotton previously heated to 110° C. is less able to absorb water vapour, probably because it has lost some volatile non-cellulosic constituent; soda-boiled cotton shows no such difference in behaviour after heating.