RESEARCH ITEMS

Distribution of types of *C. diphtheriæ*

H. D. WRIGHT has analysed the incidence, severity and age-distribution of 8,040 infections caused by the three types of *Corynebacterium diphtheriæ* (*J. Path. and Bact.*, **52**, 283–294; 1941). The cases were notified in Liverpool during the four years 1937–1940; and there were 475 deaths (5·9 per cent). The *mitis* type was cultivated from 29·8 per cent, the *intermedius* type from 18·9 per cent, and the *gravis* type from 51·3 per cent of the total cases of diphtheria in the period under review. The figures show that the incidence of the *gravis* type increased each year from 34·2 per cent in 1937 to 69·6 per cent in 1940, but that the *mitis* and *intermedius* incidence correspondingly decreased. The proportion of the *mitis* cases in each year that were included within the age-group 0–4 was higher than that of the *intermedius* and the *gravis* cases in this age-period; and, similarly, the *intermedius* percentage figures were higher than those of the *mitis* type for the ages 10–14. The case-fatality rate, over the whole period, of infections with *mitis* was 2·2 per cent; for *intermedius* it was 10·7 per cent; and for *gravis* it was 6·3 per cent. The proportion of toxic cases was considerably greater in the *intermedius* and *gravis* groups than in the *mitis* group. The author discusses the validity of subdividing strains of the diphtheria bacillus into the above-mentioned types. This classification originated ten years ago in Leeds and has been widely confirmed, although critical reports have recently come from the United States. The Liverpool experience has convinced Wright that the types are founded on well-established criteria; that, with practice, they are readily distinguishable; and that they serve a useful purpose in helping to make clear the pathological and epidemiological features of the disease.

Isotopic Constitution of Potassium *in vivo*

POTASSIUM is known to have three natural isotopes $^{39}_{19}K$, $^{40}_{19}K$ and $^{41}_{19}K$. The 39 isotope represents the bulk of the element, the 41 isotope a relatively small fraction, while the radioactive 40 isotope occurs only in minute quantity. It is known that the abundance ratio of the 39 and 41 isotopes is not a constant figure for all organic tissues. A. Lasnitzki and A. K. Brewer (*Biochem. J.*, **35**, 144; 1941) have now studied the isotopic constitution of potassium present in various rat tissues by mass-spectrographic measurement on the ash. In the living animal a continuous potassium exchange takes place between the various tissue cells and the blood plasma. The actual potassium content of tissues is on the average perhaps twenty times higher than that of blood plasma. It was found that the isotopic ratio $^{39}_{19}K/^{41}_{19}K$ in the ashes from bone marrow and blood plasma was distinctly lower than that of ordinary mineral potassium (purified KCl) or from the ashes of other tissues. A kinetic mechanism has been proposed accounting for the observed effect depending on the condition that the intracellular potassium, in contrast to the extracellular potassium, is completely associated with heavy molecules. A fractionation of the 39 and 41 isotopes due to the difference in velocity of the ions in their passage through the cell membrane thus occurs. The isotope ratios of tissue potassium and plasma potassium do not depend solely on the mechanism responsible for their difference, but also on the isotopic ratio of the potassium which enters the blood-stream via the intestine. Fractionation of isotopes due to slight differences in chemical properties can be obtained by exchange reactions. Thus if zeolites containing sodium as a basic constituent are brought into contact with solutions of lithium or potassium salts, the sodium is exchanged for lithium or potassium, but the light isotope of lithium and the heavy isotope of potassium are taken up preferentially.

Genetics of Cotton

S. C. Harland and O. M. Atteck (*J. Gen.*, **42**, 1–21; 1941) have given important facts regarding the genetics of cotton. They have been able to introduce genes from the diploid *Gossypium Thurberi*, *G. Armourianum* and *G. aridum* to the tetraploid *G. barbadense* and *G. hirsutum*. By continual back-crossing they were able to study the effect of one gene on the background of *barbadense* and *hirsutum*. The *Armourianum* petal spot due to S^{arm} was proved to be an allelomorph of *hirsutum* R^h. On a *hirsutum* background, the size of the petal is not reduced in size or intensity. S^{ari} of *G. aridum* is another allelomorph of R^h. The character is reduced on a *hirsutum* background, where it becomes mutable, although it is stable in *aridum*. The evidence that S^{ari} of *aridum* and S^{arm} of *Armourianum* are allelomorphic to R^h of *G. hirsutum* provides proof that the tetraploid New World cottons contain two genoms of Asiatic and North American affinities respectively.

Sex-linked Albinism in the Fowl

A USEFUL new gene (*al*), giving a dingy white, pink-eyed chick, is reported by C. D. Mueller and F. B. Hutt (*J. Hered.*, **32**, 71–80; 1941). As the fowls grow, some melanin is found in the eye and a ghost pattern may be seen on the plumage. Sight, viability and productivity appear to be normal. The gene is sex-linked and raises to nine the number of genes known to be carried on the sex chromosome. It is highly probable that the mutation was found in the first generation after its occurrence.

Cyanogenesis in Lotus

ONE form of *Lotus corniculatus* liberates hydrogen cyanide when its leaves are killed, while another form morphologically indistinguishable from the first is acyanogenetic. Cyanogenesis is inherited in a tetrasomic manner as a dominant (C. D. R. Dawson, *J. Gen.*, **42**, 49–72; 1941). The observed numbers approximate to those expected on chromosome segregation. Cytological examination shows that this species is a tetraploid with $2n = 24$ chromosomes, but that quadrivalents are rare. The author points out that genetical data of segregation are safer than cytological as a criterion of autopolyploidy. It is considered that *L. tenuis*, which also has both acyanogenetic and cyanogenetic forms, is a diploid relative of *L. corniculatus*.

Reaction of Aliphatic Amines with Nitrous Acid

IT might be assumed that primary aliphatic amines of low molecular weight would react easily with nitrous acid to form primary alcohols with liberation of nitrogen according to the equation: $RNH_2+HNO_2=ROH+N_2+H_2O$, and this reaction has been shown to occur with butylamine to the extent of 25 per cent. Very little information is available on the general aspects of the reaction. F. C. Whitmore and R. S. Thorpe (*J. Amer. Chem. Soc.*, **63**, 1118; 1941) have examined the effect of nitrous acid on methylamine, ethylamine and *n*-propylamine under varying conditions. In sixteen experiments with methylamine and nitrous acid under a wide variety of conditions, no methyl alcohol or other reaction product could be isolated from the reaction mixture, some methylamine being always recovered unchanged. The amount of unchanged amine was never less than 25 per cent, and was sometimes more than 90 per cent, although conditions like those employed with *n*-butylamine were used in several cases. Solvents other than water were also used, and a reaction in the gas phase with methylamine, nitrous vapours and a trace of moisture was attempted. The amine nitrite seems to be more easily hydrolysed than decomposed. Small amounts of methyl alcohol were obtained with silver nitrite and methylamine hydrochloride. Ethylamine with nitrous acid gave a 60 per cent yield of ethyl alcohol; *n*-propylamine gave 7 per cent of *n*-propyl alcohol, 32 per cent of isopropyl alcohol and 29 per cent of propylene. Traces of ether were also formed with ethyl and propyl amines.

The Antimony Electrode

MANY investigations have been carried out on electrodes of the metal–metal oxide type. The only one of them which has met with much success is the antimony–antimony oxide electrode. The values reported in the literature for the standard potential and the slope of the *p*H curve vary widely. F. Hovorka and G. H. Chapman (*J. Amer. Chem. Soc.*, **63**, 955; 1941) have obtained very satisfactory antimony electrodes by casting pure antimony (obtained by electrolysis from hydrofluoric acid solution) into sticks under reduced pressure. These castings were free from surface pits and were very lustrous; they were cleaned by electrolysis in sodium carbonate solution and repolished before use. The sticks were immersed directly in the buffer solutions and the other electrode was a hydrogen electrode. It has been known for some time that it is unnecessary to add any antimony oxide. The potential at 25° was found to be $0{\cdot}2552 - 0{\cdot}05893$ *p*H referred to the normal hydrogen electrode, a deviation of the potential at *p*H = 8 reported by other investigators being confirmed. Between *p*H 2·2 and 8 the slope of the curve was constant, and the value 0·05893 is quite close to the value 0·05912 predicted by the Nernst equation.

Heat Capacity of Nickel Sulphate

ONE of the more important problems arising from the use of the third law of thermodynamics is the persistence of multiple electronic states in some solids at low temperatures. This is indicated by a change of magnetic susceptibility with temperature. Heat capacity measurements give no indication of the entropy contribution due to these states unless they are carried to such low temperatures that the electronic contribution is 'frozen out'. In a study of the heat capacity and magnetic susceptibility of nickel sulphate heptahydrate, $NiSO_4, 7H_2O$, at liquid helium temperatures, Stout and Giauque (*J. Amer. Chem. Soc.*, **63** 714; 1914) find that the electronic system makes a large contribution to the heat capacity at temperatures where the lattice energy is unimportant, and there is a maximum in the heat capacity about 1·8° abs. The entropy contribution associated with the electronic system is shown to be $R \ln 3$, which shows that the system has three electronic levels. These are about equally separated by about 2·6 cm.$^{-1}$, equivalent to 7·4 cal. mol^{-1}. The character of the heat capacity curve of the substance down to 15° abs. gives no indication that electronic entropy exists, so that if it were extrapolated on the assumption that no abnormal change would occur at much lower temperatures, the calculation would be in error by 2·2 cal. deg.$^{-1}$ mol^{-1}. The adiabatic change of temperature on magnetization was also measured.

Ionization of Sulphurous Acid

IT is established that sulphurous acid ionizes in two stages: $SO_2 + H_2O \rightleftarrows H_2SO_3 \rightleftarrows H^{\cdot} + HSO_3' \rightleftarrows 2H^{\cdot} + SO_3''$, and the values of the two dissociation constants have been determined. The first ionization constant has been calculated fairly recently, but with the assumption that the activity coefficient of sulphurous acid is the same as that of hydrochloric acid for the same ionic strength. The second ionization constant had not been determined by a modern method. H. V. Tartar and H. H. Garretson (*J. Amer. Chem. Soc.*, **63**, 808; 1941) have determined both constants by electromotive force methods involving the use of glass electrodes containing suitable buffer solutions. For the first constant the electrolyte was a solution containing sodium chloride and sodium hydrogen sulphite with excess of sulphur dioxide, and for the second dissociation constant the solution contained sodium chloride or bromide, sodium sulphite and sodium hydrogen sulphite, the terminals at each side of the cell being silver and silver halide in both cases. A special investigation of the solubility of silver chloride in sodium sulphite disclosed the existence of the complex ion $Ag(SO_3)_2'''$. The values of the thermodynamic dissociation constants at 25° found were: $K_1 = 1{\cdot}72 \times 10^{-2}$ and $K_2 = 6{\cdot}24 \times 10^{-8}$. The first is in fair agreement with previous determinations by conductivity methods; the second is only in qualitative agreement with other reported values made by much less accurate methods.

Researches on the Meson

THE mesons (mesotrons) found in cosmic radiation are supposed to be capable of spontaneous decay. W. M. Nielsen, C. M. Ryerson, L. W. Nordheim and K. Z. Morgan (*Phys. Rev.*, **59**, 54) have measured the mean lifetime of the meson by comparing the intensity of the hard cosmic rays under a graphite block on top of a mountain with the intensity measured at a lower altitude under an additional layer of atmosphere equivalent in mass to the carbon. The absorption of the mesons in the air and the carbon is the same, and the lower intensity under air is ascribed to the spontaneous decay of the mesons in the time required to traverse the air layer. The calculations of mean lifetime do not depend on assumptions regarding the energy distribution of the particles or the height in the atmosphere at which they are produced. The result obtained is about 1·25 microseconds (for a meson mass 200 electron masses), which is appreciably shorter than previous estimates. Nordheim (*ibid.*, **59**, 554) calculates the ratio of hard and soft component

of the cosmic rays at sea-level, taking this decay period, and considers that the soft component observed is smaller than that calculated on the view that the products of decay are a proton and an electron, and he suggests that some of the energy is carried off by neutrons. F. Rasetti (*ibid.*, **59**, 613) has used a coincidence counter system to count occasions on which a meson is absorbed in iron and a shower is emitted after a delay of a few microseconds. This event is supposed to be the stoppage of a meson followed by decay and the emission of an electron which initiates a shower, and an analysis of the delay results indicates that the life of the meson at rest is about 3 microseconds. L. Leprince-Ringuet, S. Gondelsky, E. Nageotti and R. Richard-Foy (*ibid.*, **59**, 460) have analysed a cloud-chamber photograph of a collision between a cosmic ray meson and an electron. The collision took place in a magnetic field, and by good fortune all the track curvatures are suitable for accurate measurement. The mass of the meson is therefore obtainable and the authors estimate it at 240 ± 20 electron masses.

A Neutrino Theory of Stellar Collapse

G. Gamow and M. Schoenberg (*Phys. Rev.*, **59**, 539) have suggested a novel process to account for the appearance of stellar novæ. At the very high temperatures and pressures which exist in the deep interior of a contracting star, nuclear processes may be expected in which neutrons are formed. These particles can escape from the interior without giving up energy, and thus provide a mechanism for cooling the star from the centre. As the centre of the star collapses from this cause, layers just outside the centre are left unsupported and fall in, much gravitational energy being converted into heat. It is shown that the process which takes place involves simultaneously the collapse of the inner layers and the rapid expansion of the outermost layers, with great increase in the luminosity of the star. The process grows more and more violent as the pressure and temperature of the central regions increase. The marked difference between 'novæ' and 'supernovæ' is probably to be ascribed to a difference in mass, since it has previously been shown that a star having less than a certain central mass contracts to a stable configuration of definite radius while bigger stars are subject to unlimited contraction.

The Great Spot on Jupiter in 1939

B. M. PEEK has discussed his twenty-five observations of a dusky spot at the north edge of the South Temperate Belt of Jupiter during July 31–Dec. 21, 1939 (*Mon. Not. Roy. Astro. Soc.*, **101**, 2; 1941). On plotting these observations against the time, they suggested a damped oscillation of some kind, superposed upon a fairly uniform decrease of longitude. Wildt and Peek have shown that the density of Jupiter's atmosphere must increase very rapidly with the depth, unless the internal temperature is high, and it is fairly certain that in the lower strata the gas is practically indistinguishable from a liquid except for the absence of a bounding surface. In his presidential address to the British Astronomical Association (*J. Brit. Ast. Assoc.*, **50**, 2; 1939), Peek expressed the view that masses of light solids which were floating in denser gases might explain some of the surface phenomena of the planet. It is now suggested that the spot observed was associated with the presence of a solid body performing vertical oscillations near the level at which it would have floated in equilibrium. It is possible to derive the density gradient and also the compressibility of the atmosphere at the equilibrium level from the hypothesis. Unfortunately for the hypothesis, the compressibility should be multiplied by a factor 10^7 to make it commensurable with the compressibility of typical fluids.

Dimensions of the Andromeda Nebula

THE great nebula in Andromeda, as seen visually on suitably exposed negatives, can be easily contained in an ellipse measuring $3° \times 1°$. Direct photo-electric measurements made at the focus of the 100-in. telescope at Mt. Wilson have suggested that in reality it extends nearly to $6° \times 1{\cdot}5°$. R. C. Williams and W. A. Hiltner (*Pub. Obs. Univ. Mich.*, **8**, 103; 1941) have recently extended these limits still farther on a long-exposure Mt. Palomar photograph taken with the 18-inch $f/1{\cdot}9$ Schmidt camera. The direct-intensity microphotometer used for tracing isophotes on this negative easily measures a density difference of 0·003, and shows that the apparent diameter along the major axis must be at least $6{\cdot}7°$, corresponding to a real diameter of 80,000 light-years. The surface luminosity at these outer regions is only about 27·8 mag./sec.^{2}. The outer isophotes reveal two hitherto unsuspected elongated extensions of the nebula lying on opposite sides of the major axis and suggesting a slight counter-clockwise curvature, though the well-defined inner arms are curved clockwise. This work still further reduces the discrepancy in size between the Andromeda nebula and our own galaxy: we must now regard ourselves as inhabiting a galaxy the dimensions of which, though large, are not of a different order of magnitude from those of neighbouring nebulæ.

Birth Distribution of Sunspots

G. H. A. ARCHENHOLD has constructed a frequency curve of observed first appearances of sunspots (*Mon. Not. Roy. Astro. Soc.*, **101**, 2; 1941). The work is based on Minnaert's method (*Astron. Nach.*, **263**, 13; 1937; also **268**, 81; 1939) with slight modifications. Minnaert's construction gives, for any individual form of life-curves of sunspots, the number of spots which reach the minimum size necessary to be detected in a given interval of longitude. But this theoretical number can only be compared with the one observed at that longitude if the first appearances of sunspots were recorded by continuous observation, and as most statistics are based on daily observations, the first appearances are registered too late—in other words, they are registered in a more westerly position. In addition, spots having a duration of less than 24 hours may completely escape observation. The mean daily synodic motion of a sunspot is $13{\cdot}2°$, for which reason, in the case of daily observations, a spot will be seen somewhere in the interval of $13{\cdot}2°$ following the point where it reaches the limit of visibility, and Archenhold adopts this procedure to make the theoretical results comparable with the observations. A full explanation with examples is given. The curve of visibility derived for the Greenwich instruments has been applied, as the results of the investigation are compared with the Greenwich observations. The figure representing the birth distribution shows a very decided correspondence between the theoretical distribution and that observed at Greenwich between 1886 and 1935. It justifies certain assumptions which the author has made on the curve of visibility, on the form and number of the life-curves of spots, and on the intervals in which the observations of the sun are made.