RESEARCH ITEMS

Putrescine in the Biosynthesis of Hyoscyamine

In plants of Atropa belladonna and Datura stramonium, growing normally, hyoscyamine appears to be formed principally in the root, with putrescine as an intermediate metabolite, and then moves upwards through the vessels into the stem, leaves, fruit and seeds (B. T. Cromwell, Biochem. J., 37, 717 and 722; 1943). The author's previous work on the biosynthesis of berberine and hyoscyamine had led to the conclusion that these alkaloids are synthesized from products of carbohydrate and protein breakdown. Work on the nature of the intermediate reactions leading to the formation of hyoscyamine, by experiments on exudates of cut stems, grafting and slow injections of various substances into stem stumps or branches of Atropa belladonna and Datura stramonium, showed the root as the probable locus of synthesis, and demonstrated the stimulating effect of arginine, hexamine, formamol and especially putrescine. This is compared with results of other workers (for example, Dawson, Science, 94, 396; 1941), who concluded that nicotine is synthesized mainly in the root of the tobacco plant and that the alkaloid moves from the root system via the xylem to the leaves. It was of interest to determine the manner in which putrescine provided its contribution to the hyoscyamine molecule. Bearing in mind the use of succinaldehyde in the synthesis of tropinone, it might be concluded that putrescine gives rise to succinaldehyde by oxidation. The occurrence of an enzyme system bringing about the oxidative deamination of putrescine with formation of ammonia and an aldehyde in roots and etiolated shoots, and the isolation of small amounts of putrescine from leaves and upper stems of Atropa belladonna and Datura stramonium, add weight to these considerations.

Biology of the Albacore

Vernon E. Brock has discussed ("Contribution to the Biology of the Albacore (Germo alalunga) of the Oregon Coast and other Parts of the North Pacific". Stanford Ichthyological Bulletin, 2, No. 6; Dec. 1943. Contrib. No. 10, Department of Research, Fish. Commission of Oregon) the albacore fishery in connexion with the probable causes of the sudden reduction in abundance off the coasts of California. This is the result of the first four years study and describes certain biological features in the albacore populations of the Pacific coast with emphasis on those of Oregon, and presents a review of all available material on the species from other parts of the North Pacific in so far as the material bears on the fishery problems. Fish with ripening ova are not present in the Oregon fishery and have never been recorded from the Californian fishery. It is probable that those forming the fishery have never spawned. The available evidence strongly suggests that only a few year-classes are present in the temperate-water fisheries for this species and that these are immature. This may, at least in part, account for the history of instability shown by the Californian fishery and may cause a similar instability in the Oregon fishery. The populations exploited by the North Pacific albacore fisheries may represent three different stocks or races which centre off the coasts of North America, Hawaii and Japan. The existence of albacore in mid-Pacific at positions roughly midway between these localities makes it appear possible that a certain amount of mingling may occur. It is not known if those fish occurring offshore represent wholesale migratory movements, but if so, the study and conservation of this species would cover the entire North Pacific Basin.

Mutations in Bacteria

The nature of variation in bacteria is a theme upon which disagreement exists. G. Luria and M. Delbruck (Genetics, 28, 491; 1943) have discovered some important facts regarding this problem. Escherichia coli B. in culture with bacterial virus 9 first shows complete lysis and then, after a few hours, secondary cultures make their appearance. These consist of cells which breed true to resistance to attack by the virus. The distribution of resistant bacteria in the various cultures of sensitive bacteria was ascertained. The fluctuation in the number of resistant bacteria was considerably higher than could be accounted for by sampling error. On the theory that the resistance is due to acquired immunity, there will either be a binomial distribution or a Poisson series if the numbers are small. On the mutation theory the assumption is that there is a fixed chance of change per unit time, which is measured in cycles of bacterial division. The authors show that a variance much greater than unity is to be expected. In every case, the experimental results accord with the calculations on this theory, with a discrepancy of even higher variability than expected. The mutation-rate was determined experimentally to be $2 \cdot 45 \times 10^{-8}$ per bacterium per division cycle.

New Species of Aquatic Fungi

Two papers recently published by C. F. Ingold (Trans. Brit. Mycol. Soc., 26, Pts. 3 and 4, 104 and 148; Dec. 1943) describe four new species of aquatic Hyphomycetes. Dendrospora erecta and Piricularia anomalum were found on decaying submerged oak leaves. The former species necessitated also the creation of the new genus Dendrospora, the main criterion of which is the production of tree-like spores, as the name implies. Tricladium anomalum was found growing on decaying submerged leaves of Typha latifolia, while Triscelophorus monosporus inhabited leaves at a later stage of decay, too rotted for identification. Triscelophorus is also a new genus. It seems possible that aquatic Hyphomycetes are of fairly wide distribution. Dr. Ingold has recorded several species upon decaying sweet chestnut and hawthorn leaves in addition to oak and alder leaves as described in an earlier paper.

Continental Drift and Fossil Floras

In a study entitled "Continental Drift and Plant Distribution" (privately printed, 1943), Prof. D. H. Campbell, of Stanford University, California, argues that, from a comparison of the existing and fossil floras of the northern and southern hemispheres, it is clear that the two areas were completely separated up to the end of the Mesozoic period, and that North America and Eurasia have always been more or less intimately connected. The relations between the genera and even species of New Zealand and Chile, and West Africa and Brazil, are so close that former land connexions must be assumed. Most of the common forms could not have been transported by ocean or air currents. The almost complete absence from the southern continent of the characteristic

boreal trees, such as Pinaceæ, Fagaceæ, Salicaceæ, Magnoliaceæ and others, and the absence in the northern hemisphere of many austral families, like the Myrtaceæ and Proteaceæ and the coniferous Araucaria and Podocarpus, is evidence of the complete separation of boreal and austral land masses from late Palæozoic to late Mesozoic times, and confirms Du Toit's theory of two original land masses of Laurasia and Gondwana rather than Wegener's theory of Pangæa. When the first connexions between the two were established is not certain. The paper contains a great deal of closely reasoned evidence.

Meteorites and an Earth-Model

UNDER this title R. A. Daly discusses the old hypothesis that the materials of the substratum and core of the earth are likely to be closely similar to those of average meteorites (*Bull. Geol. Soc. Amer.*, 54, 401 ; 1943). The paper summarizes the principal observed facts about the nature of meteoritic stones and irons, and the reasons for supposing them to be fragments of a disrupted parental planet. After comparison between the latter and the earth itself, the hypothetical evolution of the earth is tested by reference to the terrestrial discontinuities revealed by seismic evidence, and to mean density, moment of inertia, radioactivity and plasticity. Rough estimates of the temperatures and the degrees of strength of the materials in depth are deduced. The author assumes the earth to have been initially gaseous with a temperature well above the boiling point of iron (about 3,000° C.) and traces the probable effects of condensation and differentiation. The suggested course of development leads to an earth-model which has the following succession from surface to centre : a crust or lithosphere ; a thicker vitreous asthenospheric (weak) shell ; a still thicker crystallized mesospheric shell ; and a nickel-iron core, probably fluid and possibly behaving much like a gas. It is frankly confessed that the processes envisaged fail to account satisfactorily for the existence of a sharply defined radioactive layer. Moreover, no attempt is made to apply tests of a dynamical character, that is, to confront the model with the geological facts of mountain-building and vulcanism. Nevertheless, quite apart from its conclusions, some of which are necessarily highly speculative, the paper is extremely valuable as a compendium of all the relevant data by which such speculations must be guided.

Reaction Kinetics in Solution

IN the Tilden Lecture to the Chemical Society (*J. Chem. Soc.*, 629 ; 1943) R. P. Bell gave an account of some attempts to calculate velocity coefficients on the basis of activation energy. The fundamental equation was proposed by Arrhenius, and for bimolecular reactions is $k = Ae^{-E/RT}$, where E is the activation energy, having values from 7 to 40 k.cal. per mol. The values of A vary considerably $(10^2 - 10^{19})$ and, although the values are distributed over the whole range, smaller values apply to reactions between uncharged molecules and larger values to reactions between ions. The A values have been interpreted either as giving the product of the collision frequency Z and a so-called probability factor P, namely, $A = ZP$, and also on what is called a transition state theory, in which the equilibrium constant K for a state X through which the reacting molecules pass during reaction $(A + B \rightleftharpoons X)$ and the thermal velocity v, which does not vary greatly from one reaction to another, are connected by the equation $k = Kv$. It appears that in solution Z is not greater than four times its value for the reaction in the gaseous state. The question of solvation is an important one, and is dealt with rather fully in the lecture. In a series of solvents A and E are found to change in a parallel manner. The lecture gives a concise yet comprehensive survey of the subject with which it deals.

Boundary Lubrication and Heat of Absorption

FOLLOWING an earlier investigation of the effect of temperature on the boundary lubrication of mild steel surfaces by a number of pure long-chain compounds, J. J. Frewing has now published a study correlating the results with heat of absorption (*Proc. Roy. Soc.*, A, 182, 270 ; 1944). The frictional behaviour between mild steel surfaces lubricated with solutions in white oil of long-chain halides and other compounds was studied under high loads at low speeds. For all compounds a transition from smooth sliding to stick-slips occurs at a temperature characteristic of the particular solution used. The transition temperature increases with the concentration. Each solution builds up, and is in equilibrium with, an absorbed and oriented film of the polar compound on the surface. By assuming that the transition occurs when the surface concentration of this film decreases to a certain value which, for any one material, is independent of temperature, an equation was deduced relating the concentration and transition temperature with the heat of absorption (U). The equation fits the experimental results well. From the values of U it appears that these long-chain polar compounds are adsorbed by the interaction of their dipoles with the atoms in the metal surface and not by any chemical reaction. The results also suggest that the esters are similarly oriented at metal and at aqueous surfaces.

Polarization in Fraunhofer Lines at the Sun's Limb

DR. ZANSTRA showed in 1941 that if atoms in the solar atmosphere acted like classical oscillators, light within Fraunhofer lines should be polarized near the sun's limb (*Mon. Not. Roy. Astro. Soc.*, 101 ; 1941). R. O. Redman examined the solar spectrum at $\sin \theta = 0.985$, and was able to obtain only a small amount of polarization in the line 4227, Ca I, the observed effect being only about one tenth of that predicted by theory. Zanstra showed later that collision damping would reduce the predicted polarization very considerably, and Redman has suggested recently that the polarization would be weakened by the roughness of the sun's surface (*Mon. Not. Roy. Astro. Soc.*, 103, 173 ; 1943). Fresh observations have now been made by Redman at the Radcliffe Observatory, using an improved method (*Mon. Not. Roy. Astro. Soc.*, 103, 6 ; 1943). A description of the apparatus is given. By suitable arrangements the observations are much more accurate than those previously obtained. In addition to certain precautions, check photographs were made at the centre of the sun's disk, where there should be no polarization, these being taken immediately after the limb photographs. The results confirm the previous conclusion that polarization in the Fraunhofer lines is much smaller than was predicted by Zanstra's original theory.