

smaller size of the eggs (0.4 mm.) in *G. neilli* and also to the great difference in temperature conditions being 14°C. near Plymouth and 25°C. in Madras. Orton and others have drawn attention to the effect of temperature on the breeding of several marine animals.

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Research Notes.

Intra-cellular Inclusions in Tobacco Ring-Spot.

THE list of plants affected by viruses or ultra-microscopic organisms is quite large extending to a large number of species. Of these, only in a few cases, the diseased cells are characterised by the occurrence of intra-cellular inclusions. The latest addition to this group is the ring-spot of tobacco which has been re-examined by Woods (*Contr. Boyce Thompson Inst.*, 5, 419, 1933), who has established the presence of such bodies in plants infected under green-house conditions. These are found to occur in all cases of primary lesions in the several varieties of tobacco studied. In the case of *N. tabacum*, however, they were present where the lesions were systemic. Ring-spot disease is also observed to affect *Petunia* sp. where a similar observation has been made.

The occurrence of these inclusion bodies has been investigated with particular reference to structure, position in the cells, and distribution in the affected leaves. The bodies are always found in association with the nucleus. Non-lesioned areas did not show any such body in them. In the lesioned spots, the cells in the central portion had a greater number of bodies than those in close proximity to the necrotic areas. In these cases, the cells appear to have undergone considerable disintegration. Where the bodies were present, the cells containing them did not show visible signs of degeneration. But the development of the bodies could directly be correlated with the formation of visibly lesioned areas in the leaf.

In an affected plant, the growing point and tender shoots, although they showed partial necrosis, did not contain the bodies. As a rule, the oldest and largest cells contained them. The occurrence of these is more easily traceable to the metabolic condition of the cell at the time of inoculation, rather than to the lapse of time during which the virus remains in the cell. The bodies were generally observed to be vacuolated. Besides the vacuoles, certain other inclusions were detected within the bodies chiefly, the red staining cuboidal bodies. From the manner of their occurrence in the cell cytoplasm also, the author imagines them to be protein crystals.

The state of aggregation of substances in the diseased cells, lend the view that these vacuolated inclusion bodies represent an accumulation of certain materials in the cytoplasm. In a few instances of primary lesions the bodies were noticed to have a membrane-like periphery. The appearances and staining reactions reveal a striking resemblance to masses of young cytoplasm.

The study is important from the point of view of the origin and development of the intra-cellular inclusion bodies characteristic of virus diseases of plants. V. I.

Discovery Reports—Sponges.

IN the "Discovery Reports" (Vol. VI, pp. 239-392, plates xlviii-lvii, 1932) issued by the Discovery Committee, Colonial Office, London, Maurice Burton of the British Museum (Natural History) has given an exceedingly interesting account of the

Sponges collected during the years 1925-1929 by the R. R. S. 'Discovery' and the R.R.S. 'William Scoresby' in the course of their cruise in the South Atlantic Ocean, and by the staff of the Marine Biological Station at South Georgia. The collections include representatives of 168 species and varieties of which only 35 are new. The descriptive part of the account is preceded by a systematic list of the species under report and a list of the stations with the names of species collected at each. It is impossible within the short space of a review to refer to all the points of interest raised and discussed by the author, but the more important ones, such as the correlation between the distribution of Sponges and the main surface currents of the oceans, the embryonic development and its value in systematic study, and the significance of external form in the identification of Sponges, may be referred to in the briefest manner possible.

To the beginner in the systematic study of Sponges, confused by the bewildering multiplicity of genera and species based not infrequently on worthless characters, discernible only by their authors, the present report seems to hold out a promise that on a careful study of a large number of specimens of the various species from one or more localities, the number of the so-called genera and species will be reduced, in the not distant future, to an extent that will prove an inducement for more extended study of this group. The author's remarks in the systematic account under *Isodictya setifer* (Topsent), *Amphilectus fucorum* (Esper), *Iophon proximum* (Ridley), and *Tedania massa* (Ridley and Dendy) seem to justify this statement.

In the section on Geographical distribution the author dilates on the controversial but highly interesting hypothesis that despite the barriers set up by temperature the main oceanic currents act as the agents of distribution of Sponges, and that transportation by currents may possibly happen in the post-larval stages of some species, at any rate, when the young Sponges, in most cases, are in the form of thin incrustations on floating objects. The fact that some species of Sponges are common to both Australia and the West Indies, and to the west coast of Africa and the Indian Ocean seems to support this hypothesis. He then goes on to describe the two well-defined areas of distribution each with its distinctive fauna—the Indo-Pacific *cum* Indian Ocean, which he terms the Indian Ocean area, and the South

Atlantic area including the portion below a line approximating to the equator, both with their practically closed systems of currents, and how at the meeting point of the warm Agulhas and the cold Benguela currents south of the Cape of Good Hope, and of the warm Brazilian and the cold Magellan currents on the South American coast at a line level with Beunos Aires, effective temperature barriers are formed which prevent a general mixing of the species in the two well-defined areas. While, as pointed out above, some species common in the Indian Ocean area are also found on the west African coast and in the West Indies, no species of the South Pacific area are found in the S. Atlantic beyond the Beunos Aires barrier. This fact shows that while in one case the temperature barrier is incomplete, in the other it is complete. In the author's opinion a more important deciding factor in the matter of distribution is the relation of the two currents which constitute the barrier, that is to say, whether the currents running in opposite directions do really oppose as in the case of the Beunos Aires barrier, or only run parallel to each other as in the Cape of Good Hope barrier. In the latter case the migration of species from the Indian Ocean area to the West Indies through the S. Atlantic along the west coast of S. Africa following the flow of the Benguela current, and thence into South Equatorial becomes intelligible. So far as the Sponge fauna of the S. American coast is known, no species south of the Beunos Aires barrier is found north of it. The author's explanation for the completeness of this barrier is both ingenious and plausible. "Since the currents are opposed, any mixing that may take place is nullified by the fact that the cold current from the south encounters and passes under the Brazilian current, continuing its journey northwards beneath the surface. In this way any floating bodies reaching the northern current will be restored once again to the warm surface waters of the South Atlantic." It is refreshing to note that the author has an open mind on the subject, and emphasises the need for a thorough test of his hypothesis by extensive observations in other parts of the world, not merely for Sponges, we hope, but for other groups of the marine fauna as well.

In the section on the embryonic development of Sponges the author points out the possible value of the embryos (at least in preserved material) to the systematist, and

proceeds to describe the embryos of some species of *Tedania* with clear sketches of all the stages found, and of several species belonging to various other genera. On pages 342-345 of the report this point is greatly elaborated in reference to the species of *Tedania* which amply justifies the author's faith in embryological data as the "deciding criterion in systematic work". It is to be hoped that the lead given by him in this respect will be followed by other workers on the group.

In another section of the report (pp. 375-378) the value of external form in the identification of Sponges is referred to, and the various criteria on which identification of Sponges is based are critically examined. According to the author, the most reliable guide for the diagnosis of families is the categories of spicules present, for that of genera, the arrangement of the various elements of the skeleton with minor variations in shape, and for that of species, the external form with minor variations in the arrangement and categories of spicules present. The role of environmental factors in determining the shape of a Sponge should not, however, be overlooked, and in the description of Sponges details of habitat and associations are a great help in judging the precise limits of a species. Much of the confusion in systematic Spongology can be avoided by careful and adequate descriptions of species from entire Sponges, with due attention given to the variation in the shape and size of spicule categories, and to the external form. The author's remarks on these points deserve a careful study.

H.S.R.

Secretion of the Pancreas and Salivary Glands.

E. S. DUTHIE (*Proc. Roy. Soc. Lon.*, **B. 114**, No. 786) has extensively examined the behaviour of the cytological constituents and their relation to secretory activity in pancreas and salivary glands. Confining his studies to the mouse and frog, the author determines the value of mitochondria and golgi in secretion in these two types of glands. In the pancreas observations on living cells by the intravital method of staining have revealed the origin of the zymogen granules in relation to mitochondria. The migration of these granules towards the golgi area has been actually observed in living cells. Contrary

to the views of Parat the vacuome has no relation to the golgi body. In the salivary glands the conclusions of the author have been largely deductive. The occurrence of the secretory granules at the base of the cells and away from the golgi area has led the author to think that the granules arise in relation to the mitochondria. The account mostly confirms the conclusions of Hirsch. Stimulation of cells is seen to produce fat granules in both kinds of cells, probably as a result of the disintegration of the mitochondria.

Rains of Fishes in India, with a Note on their Meteorological Aspects.

THE following is a summary of an interesting paper read by Dr. S. L. Hora before the ordinary monthly meeting of the Asiatic Society of Bengal held on the 4th December.

In the *Statesman* of the 14th of September, 'Kim' published a short note on three rains of fishes in the Muzaffarpore District. The information was supplied to him by an eye witness, Mr. G. T. Gill of the Bhicanpur Factory. Kim's note was followed up by the author with the result that a great deal of valuable information has been collected through Kim's numerous correspondents, some of whom supplied information direct to the author. Since the 15th of September the *Statesman* has been publishing accounts of rains of fishes from time to time and it would seem that the phenomenon is still regarded by the general public with scepticism and that any explanation showing fish falling from the sky is considered a myth.

The first two records of rains of fishes in India were published in 1833 in the *Journal of the Asiatic Society of Bengal* by James Prinsep, the celebrated Secretary of the Society, and upto the present time 10 instances had been recorded, the last being in 1852 at Poona. It is undoubtedly true that every fall of fishes that occurs is not recorded, but the phenomenon is sufficiently unusual and striking to have attracted the attention of a number of people. Kim's column in the *Statesman* has unearthed several such records which would have passed unnoticed otherwise. The author gives particulars of the Rains of Fishes hitherto recorded from India, including those that fell during this year, and mentions

the species of fish known to have fallen with rains in India. The kinds of fishes that rained in Muzaffarpore in July and August last will be exhibited and attention will be directed to their mode of life, etc.

Five explanations of the rains of fishes have been advanced, namely, (i) hatching out of eggs after heavy rainfall; (ii) fishes wrongly supposed to have fallen with rain might have been migrating overland from one stream or pond to another; (iii) fishes might have been left behind by overflows after heavy floods; (iv) fishes may have been aestivating and have been awakened by the coming of the rain; and lastly (v) the rains of fishes are due to the action of heavy winds, whirlwinds, and waterspouts. All these

explanations are discussed by the author and it is indicated that the only explanation tenable is that of whirlwinds and waterspouts. The popular belief of the people of northern Behar regarding waterspouts is given, and in his note Dr. S. N. Sen, Meteorologist at the Alipore Observatory, has shown how waterspouts may be formed in India and by analyzing the meteorological conditions on the two days of occurrence of the rains of fishes in the Muzaffarpore District has shown that during those days the weather conditions were most favourable for the formations of waterspouts over that area. Several other meteorological problems regarding the falls of fishes in India are also discussed.

The Theory and Practice of Drying.

UNDER the joint auspices of the South Indian Science Association, Bangalore, the Society of Biological Chemists, India and the Indian Chemical Society (Madras Branch), an interesting discussion on the "Theory and Practice of Drying" was held on Sunday, the 12th November 1933, in the Central College Chemistry Lecture Theatre, Professor H. E. Watson of the Indian Institute of Science, presiding.

In the course of his opening remarks, Dr. Watson drew attention to the great importance of drying in science and industry. In a tropical country such as India where plenty of sunshine was available, and industries were not highly developed, the problem had not received as much attention as it had in those places less favourably situated, since sun-drying sufficed for many purposes. This simple process, however, was apt to become impracticable when large quantities of material had to be handled and in many cases contamination by dust would render a product unmarketable. It was essential therefore to pay attention to more complicated methods.

Although the theory of drying was similar for all materials, in practice there were wide differences in the methods of treatment. In the first place the temperature to which the material might be subjected was of importance. At one end of the scale were found substances which might be raised to a red heat without deterioration and at the other those which had to be dried at a temperature not exceeding that of the body. A second consideration was the physical nature of the material. With goods such as textiles, the rate of drying depended almost entirely upon the quantity of hot air or other drying agent which could be supplied, while with clays diffusion in the material itself was the controlling factor. In addition to these general considerations a special technique was required in many cases and thus it was evident that the problem was one of great complexity.

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THEORY OF DRYING—I. M. A. Govinda Rao.—When solids of appreciable thickness are dried,

the moisture must, by some mechanism or other, travel from the interior out to the surface before it can escape into the surrounding drying medium. This mechanism determines the particular variables which govern the rate of drying and the quality of the product.

Materials of fibrous or colloidal nature when brought into contact with air of definite temperature and humidity, will dry up only to a limiting moisture content, known as the "equilibrium moisture content" or 'regain'. It is just the moisture content in excess of this value that is capable of being removed by drying.

If we start with a wet solid, under steady drying conditions, the rate of drying at first remains constant and then falls off. The rate at which moisture can evaporate from a continuous film of water on the solid surface, determines the constant rate of drying, and to a certain extent also the rate during the initial stages of the falling-rate period, until the surface of the solid reaches the equilibrium moisture content. Thereafter the velocity with which water can diffuse outwards from the interior of the solid, determines the drying; the rate of diffusion, and hence of drying, falls off with decreasing average moisture content, or in other words, with decreasing average concentration difference through the solid. During this diffusional stage in drying, neither decreasing the humidity of the drying medium, nor increasing its velocity, will speed up the drying process. T. K. Sherwood (*Trans. Amer. Inst. Chem. Eng.*, 27, 90, 1931) and A. B. Newman (*Ibid.*, 27, 203, 310, 1931) have developed equations for calculating the rates of drying for different solid shapes and have represented them in the form of simple curves.

When a wet solid is drying at constant rate, moisture gradients are set up in the interior of the solid. The magnitude of these gradients is of immense importance in the drying of materials which tend to warp or crack. A differential moisture content in the body of the solid causes a differential shrinkage, which must be prevented from becoming dangerously large. E. R. Gilliland