Malpighian tubes (Fig. 3); in each of these organs the enzyme is localized in a narrow band at the inner margin of the cells. In the Malpighian tubes the restriction of phosphatase to the brush border is particularly evident where the latter does not extend completely round the inner side of the tube (Fig. 3). The enzyme distribution in the mid-gut and Malpighian tubes recalls that in vertebrate small intestine and proximal convoluted kidney tubule respectively. In the long, thin, uncoiled silk glands, which run the length of the body and open near the mouth, only the lower, or anterior, two thirds of the gland, together with the duct, show the enzyme border. In the phosphatase-containing regions of the gland, at least two processes occur: (*a*) the nature of the secretion from higher regions is altered and (*b*) a secretion different from that formed higher up the gland is produced.

The spider also showed three main sites of phosphatase activity, the silk glands (Fig. 4), the Malpighian tubes and the ovary (Fig. 5). In the maturing ovary there are several ramifying tubes and each egg is connected to one of these by a short stalk of small, closely packed cells, with prominent nuclei. Alkaline phosphatase is strongly localized around the outer borders of these cells, to which the thick outer egg membrane is attached in a manner suggesting that it may be secreted by the stalk (Fig. 5). In the Malpighian tubes the enzyme is, as before, restricted to the inner margins of the cells. The much convoluted silk glands, of several kinds, all have walls consisting of a single layer of tall, narrow cells, each with a small distinct basal nucleus and a mass of secretion droplets filling the rest of the cell. Phosphatase is restricted to the nuclei and the inner margins of the cells, where the black deposit indicating its presence is actually on the secretion droplets. The precise association may be an artefact, but it is reminiscent of the adenosinetriphosphatase activity associated with myosin. Particularly in the aciniform glands there are small areas devoid of the enzyme activity (Fig. 4), a condition comparable with Millot's[4] division of the glands into two differently staining regions.

Thus, while the silk glands of both animals have some regions devoid of the phosphatase border, it is nevertheless difficult to believe that this enzyme is not concerned at some stage in the elaboration of the finished product. Such simultaneous occurrence of alkaline phosphatase and fibrous protein production has previously been recorded in healing wounds[5], bone[6], hair follicles[7], teeth[8], and capillaries. It is also known that in the healing wounds of vitamin C-deficient guinea pigs, phosphatase activity as well as collagen production is lower than in normal wounds[9].

The evidence available at present, therefore, indicates that alkaline phosphatase is concerned in the production of many fibrous proteins. It has in fact been suggested that protein synthesis involves more than mere reversal of proteolytic activity, and there are many indications that nucleic acids participate in the process[10]. But at what point phosphatase may function in the overall picture, including both synthesis and subsequent secretion, cannot be decided at present.

J. R. G. BRADFIELD

Department of Zoology,
University of Cambridge.
May 18.

1 Takamatsu, H., *Trans. Jap. Path. Soc.*, **29**, 492 (1939).
2 Gomori, G., *Proc. Soc. Exp. Biol. Med.*, **42**, 23 (1939).
3 Danielli, J. F., *J. Exp. Biol.*, in the press.
4 Millot, J., *Bull. biol. France et Belg.*, Suppl. 8 (1926).
5 Fell, H. B., and Danielli, J. F., *Brit. J. Exp. Path.*, **24**, 196 (1943).
6 Bourne, G., *J. Exp. Physiol.*, **32**, 1 (1943).
7 Johnson, P. L., Butcher, E. O., and Bevelander, G., *Anat. Rec.*, **93**, 355 (1945).
8 Bevelander, G., and Johnson, P. L., *J. Cell. Comp. Physiol.*, **26**, 25 (1945).
9 Fell, H. B., Danielli, J. F., and Kodicek, E., *Brit. J. Exp. Path.*, **26**, 367 (1946).
10 Davidson, J. N., and Waymouth, C., *Biochem. J.*, **38**, 39, 375, 379 (1944) (list of refs.).

Symbiosis Between Myxobacteria and Nitrifying Bacteria

IN studying the biology of myxobacteria I have arrived at the conclusion that this group of micro-organisms is much more widely spread in Nature than it is commonly considered. The morphology and systematics of myxobacteria are little known to the wider circle of microbiologists, and their role in the circulation of substances in Nature has not been sufficiently studied. In 1933 I discovered cellulose-decomposing myxobacteria of the genus *Sorangium*, and it was later established that the chief agents of cellulose decomposition under aerobic conditions belong to the family Myxococcaceæ or Sorangiaceæ. This circumstance induced me to turn my attention to different micro-organisms already described in the special literature as causative agents of various transformations of carbon and nitrogen and showing some similarity to myxobacteria in their structure and history of development. The new nitrifying bacteria, discovered in soil by Romell and later by Winogradsky and Winogradskaia and described by them under the name of *Nitrosocystis*, presented particular interest in this respect. The description of these organisms and the photographs accompanying the report seemed to indicate that these authors mentioned were evidently dealing with myxobacteria.

To obtain cultures of *Nitrosocystis* I inoculated silica gel plates, impregnated with the mineral medium of Winogradsky and covered with a layer of chalk, with particles of soil. 3–4 weeks later, zones of chalk dissolution appeared around the soil particles, and gel fragments began to give a sharply positive nitrite reaction. With the help of the microscope we discovered in these zones of nitrification round fruiting bodies, myxobacteriæ of the genus *Sorangium*. The fruiting bodies reached the size of 30–40 μ and were composed of smaller polygonal cysts. These smaller cysts could be easily crushed between object- and cover-glass, and in this manner one could see that they consisted of small short rods with rounded ends. Transfers were made from the zones of nitrification to a solid medium consisting of potato-broth, peptone and agar. Colonies of *Sorangium* developed on this medium, and in these later on there appeared fruiting bodies identical with those which had been observed in the zones of nitrification. A one-cell culture was obtained and studied and its history of development was the one usually observed in myxobacteria of the genus *Sorangium*. Young vegetative cells have the shape of rods, which later become shorter and thicker. Accumulations of these shortened rods form the smaller cysts, out of which the fruiting-bodies mentioned above are formed in their turn.

The isolated cultures are heterotrophic. They develop readily in the usual nitrient media and lack absolutely the ability to oxidize ammonia, that is, to nitrify. The question naturally arises, how are we to explain the ability of these myxobacteria to develop on silica-gel plates, *that is*, on the elective medium for nitrifying microbes? The answer to this question is given by microscopic observations on the youngest zones of nitrification. Before any denuded gel areas make their appearance on the surface of the plate, isolated cells of the classical chemotrophic micro-organism, the *Nitrosomonas*, can be detected in the chalk covering this surface. Later on, the spherical cells of *Nitrosomonas* are incorporated by the accumulations of *Sorangium* cells. It follows from this that the development of the nitrifying bacteria precedes that of the myxobacteria. The first, being typical chemotrophs, synthetize the organic substance which is evidently utilized for their nutrition by the second after the autolysis of the *Nitrosomonas* cells. The mutual relations between the two species of micro-organisms seem to be possibly symbiotic, since the accumulations of mucous zoogleæ of the myxobacteriæ retain the moisture necessary for the growth of *Nitrosomonas* and may also protect the latter from external unfavourable influences. Desiring to emphasize this particular character of the bacterium I gave it the name of *Sorangium symbioticum*.

The possibility is not to be disregarded that micro-organisms, described as new species of nitrifying bacteria, are really an association of chemotrophic and heterotrophic micro-organisms.

A. IMSENECKI

Microbiological Institute,
Academy of Sciences,
Moscow.
May 11.

Preliminary Survey of the West African Rain-Forest Canopy

MAKING use, with only slight modifications, of the methods elaborated by Dr. Hingston and the staff of the University of Oxford expedition to British Guiana, we were able during the summer of 1945 to make a preliminary survey of the canopy of the rain-forest of the "Réserve forestière du Banco" near Abidjan (Ivory Coast). We built, at 150 ft. from the ground, an observation platform from which we could collect continuously in the foliage of the canopy, either directly or with light-traps. On this platform we passed numerous days and a number of whole nights.

From this platform, and from lower stations, we got complete temperature and humidity records for a number of weeks, which will be published elsewhere. The collection of animals, mostly insects, made in the canopy is being intensively studied by the various specialists concerned. But it is already possible to give a picture of the fauna of the canopy, as contrasted with the fauna of both the lower forest strata and the forest margin or clearings.

Though a number of species, living on or near the ground, and particularly the ants, *Camponotus maculatus* F. and *Œcophylla longinodis* Latr., are found up to 140 ft., the majority of the fauna of the canopy are not found in other strata of the forest: *Gyna*, Tenoderinæ, *Popillia*, many Pseudophyllids are represented by different species or genera in the canopy and under it. Many more, though they may live in the northern savannas, near the ground, are not known in the forest, except from the canopy: such are *Embia*, Mantispids and some Ascalaphids such as *Dicolpus volucris* Gerst.

An interesting fact results from the presence, in the thick layer of humus upon the principal branches of the canopy (it may be 6–10 cm. deep), of a rich fauna of soil animals: *Collembola*, *Thysanura*, Isopods, Myriapods are numerous. One can trace their path from the ground upwards, in the small pockets of earth lodged around the roots of the epiphytic plants growing along the trunks.

Most of the species of the canopy have the brilliant colours and active flight of the fauna inhabiting the clearings and the forest margins, as opposed to the sombre colouring of the underwood fauna. But the species of these two habitats are usually quite different, specifically and generically.

We may conclude that, pending a complete study of our material, the West African canopy is a particular habitat, with a distinct fauna and a special ecological climax. We were not able to define between the ground and the canopy a succession of superposed layers such as Hingston found in Guiana.

RENAUD PAULIAN

Muséum d'Histoire Naturelle,
Paris.

The Processus Muscularis and the Tensor Tympani Muscle of Bats

AN 'accessory' processus muscularis, the significance of which has not been disclosed, was described by Doran[1] in the malleus of *Asellia tridens* (Microchiroptera). The process is said to be of very rare occurrence in bats. Dissection of fresh *Asellia tridens*, however, revealed the presence of a two-headed tensor tympani muscle, the short and smaller outer head being inserted to the 'accessory' process, while the long inner head is attached to another process which Doran considers as the homologue of the processus muscularis constantly observed in other insectivorous bats. This remarkable feature of the tensor tympani to which I can find no reference in the literature is not a peculiarity of *Asellia tridens* (Hipposideridæ) alone, but is found in various other species of bats. It occurs in *Taphozous perforatus*, *Liponycteris nudiventris* and *Rhinopoma microphyllum*