

of the highest purity and about 3 cm. long. This wire is the thermal switch between the two stages. With both stages magnetized, thermally isolated from the surroundings and at 1° K., the magnet was lowered slowly so that the upper stage was demagnetized while the lower stage remained in the field. The lead wire, being still in a field greater than its threshold value, remained a good thermal conductor, and heat was transferred from the lower to the upper stage. With the magnet lowered still further so that only the lower stage was in the field and any stray field around the lead wire carefully reduced to zero, the lower stage was more or less thermally isolated from the upper, because the lead wire was superconducting and thus of considerably reduced thermal conductivity. Removal of the magnet demagnetized the lower salt and the temperature fell to the order of 0.001° K. The residual heat inflow of the apparatus after demagnetization is stated to be about 1 erg/min.

The possibility of adapting the superconducting switch to control the flow of heat between the nuclear and electronic stages in the proposed combined use of nuclear and electron paramagnetism, so as to extend the lower limit of temperature attainable, is also briefly discussed in the article.

REPRODUCTION OF THE TUBERCLE BACILLUS

A COLLOQUIUM upon "Reproduction of the Tubercle Bacillus" was held in Cambridge on December 8, 1951, at the Cavendish Laboratory, continuing in the afternoon at the Strangeways Laboratory. The meeting was sponsored by Dr. E. M. Brieger, of Papworth Hospital, near Cambridge.

The introductory address was given by Dr. K. A. Bisset, who stressed the complexity of structure of the organism and of its modes of reproduction. These appearances are often unrecognized, because of the practice of examining only well-grown cultures, and then almost exclusively by means of techniques which reveal only acid-fast stages. Dr. Bisset also suggested that it is important to try to make certain to which of the many known types of growth and reproductive activity a particular phenomenon belongs before attempting to complete its interpretation.

The relationships between mycobacteria and other Actinomycetes was indicated by E. O. Morris, who showed that many of the complex reproductive processes described in *M. tuberculosis* are quite commonly found in these apparently allied forms. He especially emphasized germination of the resting stages by means of germ tubes as characteristic of the entire group.

Dr. V. E. Cosslett demonstrated the work, which had been performed in collaboration with Dr. Brieger and Miss A. M. Glauert, upon the electron microscopy of various stages in the life-history of *M. tuberculosis*. Early cultures of an avian strain consisted of short rods which, after forty-eight hours, began to be replaced by larger, beaded filaments, and were again restored, in the later stages of culture, to the original form. Granular forms of bovine bacilli isolated from infected rabbit tissues were also examined. The larger granules, 0.5–1 μ in diameter, appeared to contain rod-like bacterial elements; this material proved to be highly infectious to guinea pigs.

A substantial degree of correlation between the interpretation of electron, phase-contrast and classical microscopy seems now to have been achieved, although the density of the putative structures, and especially of the nucleus, to the electron beam appears to vary, both relatively and absolutely, at different stages of growth. It was also pointed out, by Dr. Bisset and Mr. Morris, that many structures, especially septa and cross-walls, can be demonstrated only irregularly by the electron microscope, but are regular features of the organism as seen in stained preparations. Dr. Cosslett agreed.

Dr. C. H. Lack described some of the appearances which can be seen in synovial fluid from tuberculous joints. Acid-fast and non-acid-fast granules were seen. Slide cultures, examined stained and by phase-contrast microscopy, showed many of the forms reported in life-cycle studies by earlier workers, including 'cocci' and tetrads. 'Cocci' were observed to germinate. A syncytial stage was also observed, in which numerous nuclei were embedded in a sheet of cytoplasm. The granular forms infected guinea pigs only exceptionally, and the coccal and syncytial stages from culture gave no allergic response and were apparently non-infective, but produced splenic enlargement and marked wasting.

In the afternoon Dr. E. M. Brieger and Miss A. M. Glauert showed a series of lantern slides of their preparations of growing cultures of different types of *M. tuberculosis*. Dr. Brieger demonstrated that by the use of nigrosin as a counter-stain, the derivation of acid-fast colonies from non-acid-fast mycelial structures could be followed in avian strains. Mr. Morris commented upon the possibility that these represented primary and secondary mycelia, as in Actinomycetes and Streptomyces. Miss Glauert described similar results obtained using the phase-contrast microscope to study living cultures of avian bacilli, growing on embryo-extract-chick-plasma clots. Two main types of micro-colony were seen developing from mycelia: serpentine 'cords' of bacilli, and irregular, spherical 'hedgehogs'. Both types eventually became acid-fast although they developed from mycelia which were mainly non-acid-fast. Dr. Brieger also reported that somewhat similar results had been obtained with a bovine strain which had been injected into the intra-amniotic fluid of the egg. In response to a query, he stated that he had not separated these types and consequently had not attempted to isolate a cord factor, although the strain was highly virulent.

Reference was made by Dr. Honor B. Fell to previous warm-stage observations of living avian bacilli, when the drawings made during continuous observation of the same field showed the peculiarities of the two types of development, the bacillary and the mycelial type.

Dr. E. Klieneberger-Nobel was requested to give her views upon the relationship between the L-form in other bacteria and the granular symplasms of *M. tuberculosis*. She gave an account of the phenomenon in various bacteria, and emphasized that it frequently appeared as a reaction to an unfavourable environment.

There was much general discussion, in an informal atmosphere. An impression was achieved that much had been done to correlate the views of workers in the physical, biological and medical fields of this problem, and that the area of agreement was both surprisingly and satisfactorily wide.