two viruses, one of which persists in the aphis vector for several days and the other for not more than one day. These results, however, were obtained only by the use of aphides which were reared on the Royal Sovereign infector plants. When similar experiments were conducted with aphides given only short infection-feeds (up to 4 hr.) the aphides remained infective only for a short time, and symptoms of the non-persistent virus type alone were produced in *F. vesca*. The persistent component either was not transmitted, or was retained in the aphides for no longer than was the non-persistent component. This agrees with the results of contemporaneous experiments at East Malling[7], in which aphides fed for short periods (up to 24 hr.) on certain infector plants, including 'severe crinkle' Royal Sovereign, transmitted only a non-persistent virus.

A beginning was later made in the analysis of other diseases met with in the field. It was found that 'mild crinkle' in Royal Sovereign most probably contains only a non-persistent virus, whereas both non-persistent and persistent viruses were obtained from Royal Sovereign affected with yellow-edge; from 'degenerate' Huxley showing yellow-edge-like symptoms; and even from a normal, vigorous, clonal stock of Huxley ('Malling 44'). It is considered that the virus components of yellow-edge in Royal Sovereign and of 'degenerate' Huxley are of similar type and are perhaps identical. The viruses in normal, vigorous Huxley (M44) and in a Royal Sovereign stock (M35) showing mild crinkle are also of similar type, but are probably not identical since only the former has given definite evidence of a persistent component. The persistent viruses isolated from 'degenerate' Huxley, from vigorous Huxley and from yellow-edge in Royal Sovereign, all appear to differ from the persistent virus in Royal Sovereign plants showing severe crinkle.

These tentative groupings were supported by the results of a later experiment with the variety Huxley. Degeneration was produced in plants of the M44 clone of this variety by colonizing them with aphides (*P. fragariæ*) reared on Royal Sovereign showing yellow-edge or on 'degenerate' Huxley or Oberschlesien plants (both showing symptoms resembling yellow-edge). Degeneration did not occur, however, where the aphides used had fed on Royal Sovereign showing mild or severe crinkle or on vigorous plants of Huxley or Oberschlesien. We at no time obtained evidence that the two latter varieties can carry, without symptoms, viruses capable of causing yellow-edge in Royal Sovereign.

In the course of these studies the symptoms of crinkle in Royal Sovereign and in *F. vesca* were analysed into 'unit characters', comprising reduction in size, distortion, leaf malformation, chlorosis and pigmentation, the varying proportions of which give rise to the wide range of symptoms shown by infected Royal Sovereign plants in the field. An appreciable variability in the clinical picture also occurs among plants of either *Fragaria vesca* or *F. moschata* Duch.—even though clonal—when these are infected with either mild or severe crinkle under conditions made as uniform as possible. Many carefully investigated examples led us to the opinion that symptom variability, especially in *F. vesca* but also in Royal Sovereign, is a function not only of virus content but also of the individuality of the plant in its reaction to a given virus, and that this is a factor to be taken into account both in fundamental research and in field surveys.

This work, a full account of which will be published later, was carried out at the School of Agriculture, University College of North Wales, Bangor, with the aid of a grant from the Agricultural Research Council.

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PROGRESS IN ELECTRON MICROSCOPY

MORE than a hundred and fifty people, including visitors from the United States, Holland and France, attended the conference of the Electron Microscopy Group of the Institute of Physics which was held during September 16–17 at the University of Leeds. The meeting opened with addresses of welcome from the Vice-Chancellor of the University and from Prof. R. Whiddington; Sir Charles Darwin was in the chair.

The first session was devoted mainly to biological topics. Drs. R. Reed and K. M. Rudall (Department of Biomolecular Structure, Leeds), in a paper illustrated by many slides and enlarged micrograms, described work on gold-shadowed replicas of (*a*) the non-banded collagen-type fibres of the earthworm cuticle, and (*b*) the cell structure of striated muscle fibres from the frog. In the former case valuable information is provided on the manner of growth of the fibres and how they are arranged in layers of alternating fibre direction; while in the latter further details showing the organisation of the sarcolemma, sarcoplasm and striated myofibrils are clearly revealed. Investigations such as these, the results of which are now being reported from many countries, make it evident that the time is rapidly approaching when a new histology will have to be written.

Dr. V. E. Cosslett (Cavendish Laboratory) and his colleagues dealt with the preparation of bacteria for electron microscopic examination. Many cells are too opaque to show internal detail when using the 60 kV. beams of most present-day microscopes, but methods had been developed for rendering them more transparent, for example, by treatment with acetic acid vapour, ether vapour, or hydrochloric acid. Internal structures have also been revealed by light metal-shadowing, or by normal evaporation of metals on to the organism, or by the use of very thin supporting films of beryllium. Details of the preparation and handling of such films were given and photographs showed their obvious value in this type of study. Dr. N. E. Brieger (Papworth, Cambridge) further illustrated the methods by reference to the growth of avian tubercular bacilli on a solid medium. Dr. F. M. L. Sheffield (Rothamsted Experimental Station) described how certain plant viruses produce abnormal inclusion bodies in the cells of the host. By micrurgical methods some of these bodies have been isolated and examined in the electron microscope and their contents compared with other parts of healthy and infected cells. In cells infected with tobacco mosaic virus, the virus particles are located not only in the cell nuclei, but in other parts of the cell besides. In severe etch disease, an examina-

tion of nuclear and cytoplasmic inclusions revealed crystalline bodies, many of which show details of internal structure. In a paper by Dr. L. Dmochowski and Prof. R. D. Passey (Department of Experimental Pathology and Cancer Research, Leeds) and Prof. W. T. Astbury and Dr. R. Reed (Department of Biomolecular Structure, Leeds), extracts of normal and malignant tissues derived from mice of high and low breast-cancer strains were studied. Roughly spherical particles of about 200 A. diameter were found in the extracts of lactating breast tissues and of breast tumour tissues obtained from mice of three high-cancer strains. Extracts of lactating breast tissues and of experimentally induced breast tumours from mice of two low-cancer strains were found to be free of these particles. All extracts are being examined for tumour-inducing activity in susceptible mice, and the results of these tests are keenly awaited. [See also *Nature*, October 25, p. 565.] Dr. van Dorsten (Philips, Eindhoven) illustrated the possibilities in the use of high-velocity beams by showing photographs of yeast cells taken with electrons ranging from 70 to 300 kV. At the higher voltages there was surprisingly little loss of contrast, and internal detail was clearly seen.

The remainder of the session was devoted to problems of technique. Dr. A. E. J. Vickers (Imperial Chemical Industries, Ltd., Billingham) referred to various devices for simplifying the manipulation of grids covered with thin supporting films. The photographic methods employed at Billingham were mentioned; since the electron beam often adversely affects the specimen, photography after a fixed time interval is recommended to obtain comparable micrograms. Mr. M. E. Haine (now of A.E.I. Research Laboratories, Aldermaston) gave an account of the new Metrovick experimental microscope. The new model employs a three-lens system which allows a wide control of magnification (1,000–50,000 times at 50 kV.) with a great reduction in the size of the instrument. The pumping-out time from atmospheric pressure, even with the small diffusion pump used, is only about 2½ minutes. No air-locks are necessary, and a precision-made specimen stage of a robust design is thereby made possible. Improved electron gun performance gives usable image brightness even at the highest magnifications: at present the instrument operates at 50 kV., but higher voltages are allowed for in the design. The instrument was demonstrated at the Conference and was enthusiastically examined by a large number of visitors. A paper on asymmetry in electrostatic lenses and its correction was read by Prof. P. Grivet (TSF Laboratory, Paris). A theoretical treatment showed that lens asymmetry is due mostly to mechanical defects, and mention was made of a correcting device consisting of four solenoids spaced 90° apart which could be rotated about the axis of the lens. In discussion it was agreed that such a device would be successful, but doubt was expressed whether it would be easily workable. Dr. Bruck, of the same Laboratory, reported on a simplified form of microscope for the study of cathodic emission. The object surface (about 3 mm. in diameter) was easily changeable and could be heated to 2,500° C. by electron bombardment. Magnifications from 50 to 2,000 were provided by a two-stage electrostatic lens system, and preliminary results from various metallic surfaces were presented.

On September 17, Prof. W. T. Astbury was in the chair, and the time was devoted to problems of specimen examination. Dr. V. E. Cosslett (Cambridge) demonstrated that specimens exposed to the electron beam for some time often show a loss of contrast and considerable visible growth. These effects were especially strong on particles in direct contact with the specimen grids, but less noticeable on material supported on collodion or similar non-conducting films. Studies with different specimens on a variety of grids suggested that the effects arise from a contamination, partly from the specimen grid itself and partly from traces of organic material which are deposited on the specimen and grid. Where particle size is sought, Dr. Cosslett suggested the use of cleaned grids, a clean vacuum and specimens supported on non-conducting films. Photography in the central regions of the grid spaces was also recommended. Mr. I. M. Dawson (National Institute for Medical Research, Hampstead), in a study of the metal-shadowing technique, reported on the degree of gold aggregation occurring on different types of supporting film, as assessed by electron diffraction methods. The crystallite size of gold deposited on graphite films, for example, was found to be much greater than on collodion films. Evidence was given to show that direct shadowing of gold on to a specimen already mounted on a supporting film leads to more aggregation than if the metal is first deposited on the specimen and removed later by a stripping technique. It was considered that light metal-shadowing leads to less artefact production, and support was given for the contention that with metal-shadowed specimens further evaporation and deposition of metal may occur during examination in the microscope.

The Conference ended with a discussion on the most suitable choice of photographic material. Dr. R. Reed and Mr. A. Millard (Leeds) gave the results of testing a number of plates and films. Certain emulsions were mentioned as having ample contrast and reasonable grain size, yet showing a rapid response to electrons. The advantages of such fast emulsions were listed, the chief being that they minimize the risk of image movement during exposure. Particular emphasis was laid on the use of 35-mm. film, since the precision techniques of miniature photography can then be applied. In discussion it emerged that the high sensitivities quoted were in some way connected with small-grained emulsions of a high silver/gelatin ratio. Further tests on various plates and films were reported by Mr. I. M. Dawson, who also described a successful roll-film adaptor for use in the Siemens type of microscope. It was mentioned that when non-conducting materials are used in such electron cameras, attention must be paid to the problem of the dispersal of charge on the recording film.

In conclusion, it is gratifying to report that teething troubles in British electron microscopy are now more or less over, and that, so far as present conditions permit, the outlook is full of promise. Not only have the new techniques been learned; they are being actively applied and developed in the elucidation of many fundamental problems, particularly in the biological field. It may be claimed that the new Electron Microscopy Group of the Institute of Physics is now safely launched, and the growing membership and increasing vigour of its discussions augur well for the future.

More complete accounts of the contributions summarized above will be published elsewhere.

R. REED