The success or failure of partially or completely inactivated viruses seems to depend on the amount of material injected representing a sufficient number of infecting doses of the original virus. Formalized virus vaccines have been found useful for protection against such infections as equine encephalomyelitis and canine distemper; in vaccinia they appear to be useless. In foot and mouth disease and influenza, immunization is complicated by the existence of numerous serological types; and so far in influenza no variant has been found with the necessary combination of negligible virulence and good immunizing power.

Very little use has so far been made of the 'interference phenomenon', wherein inoculation with two viruses is followed by the development of lesions due to one of them, but by the acquisition of immunity to both. A good example is the immunity produced in fowls against fowl pox by the simultaneous inoculation of large amounts of pigeon pox and traces of fowl pox virus. Peltier in Senegal has recently inoculated a large number of natives with a mixed 'vaccine' consisting of vaccine lymph and active neurotropic yellow fever virus. Only the lesions of vaccinia appeared, and the natives were apparently immune to both yellow fever and smallpox.

Even though some virus infections (for example, fowl pox, psittacosis) give rise to little antibody response in the host, it seems clear that a humoral mechanism is the main factor in immunity, for chorioallantoic grafts of skin from fowls immune to fowl pox are as susceptible to fowl pox as grafts from non-immune fowls. When regrafted on to immune fowls and thereby bathed in the fluids of the insusceptible host, they can no longer be infected with fowl pox virus. It is not yet certain whether a high titre of circulating antibody following vaccination betokens immunity to influenza virus.

The study of virus reservoirs might give many hints in the quest for effective immunizing agents. Healthy vampire bats can carry rabies virus, many species of birds carry psittacosis and psittacosis-like viruses, fowls, horses and other mammals can carry equine encephalomyelitis and St. Louis encephalitis, while the virus of lymphocytic choriomeningitis has been isolated from wild house-mice. Under normal conditions the virus remains latent; variations in the weather, the presence of biting insects and appropriate hosts might lead to conditions in which man becomes infected.

Very important advances have been and are being made in attempts to substitute inactivated for active virus; with further developments in recovering viruses from tissues and in methods of inactivation, we may hope to ensure the preservation of antigenicity necessary for effective immunization.

Mr. J. T. Edwards pointed out that measures for the control of rinderpest necessarily differ in different countries. In India, where the native cattle are relatively immune to the disease, greater risks can be taken than in England where all the cattle are susceptible. Four methods of conferring immunity are available: (1) Injection of hyper-immune or convalescent serum (cattle or buffalo). The immunity so produced is immediate, but lasts only nine days, and is liable to produce an unjustified feeling of security, as the infection will remain latent in the herd until the effect of the serum wears off, when infection will flare up again. (2) The serum and virus method gives lifelong immunity, but is expensive and risky; unless both serum and virus are effective, it is of little value. (3) Little progress was made with inactivated virus until it was discovered that most of the virus is in lymphocytes, and that vaccination with extracts of tonsils, lymph glands and lungs of infected animals, killed at the height of the fever and inactivated with 0·7–1 per cent of formalin, gives good immunity. The procedure is safe but expensive, and the duration of immunity very variable. Calves lose their immunity early, older animals may remain immune for two years. (4) Passage of rinderpest virus in goats reduces the virulence for cattle in about eighty passages, and vaccination with this modified virus gives excellent immunity, appearing 2–3 days after inoculation. The method is effective, safe and cheap.

Dealing with swine fever, Mr. T. M. Doyle said that in immunization against this disease, virus followed immediately by serum is effective but expensive, and great difficulty has been experienced in obtaining constant products. Crystal violet vaccine, though not so efficacious, is much more uniform and comparatively easily reproducible. Infective blood is incubated for 14 days at 37° C. with disodium phosphate and 1 : 1000 crystal violet; 1 : 2000 crystal violet, though it has the advantage of not producing any precipitate in the vaccine, is not sufficiently bacteriostatic. Under laboratory conditions immunity lasts for more than twelve months. In field trials excellent results have been obtained so long as pigs were vaccinated *after* weaning; pigs vaccinated before weaning developed only slight immunity.

Dr. C. H. Andrewes remarked that bacteriophages might show the 'interference phenomenon'; coliphages, for example, might inhibit one another, even though one is inactivated with ultra-violet light. Might not interference account for immunity in vaccination against small-pox and rabies? Dr. D. Maclean directed attention to the difficulty of producing immunity to vaccinia unless a vesicle develops —even though deep lesions and local adenitis occur. Dr. C. L. Oakley mentioned the corresponding observation in influenza; if mice are immunized with formolized virus intraperitoneally, they are immune only to the homologous strain, and possess significant antibody to that strain only. When, however, they have intranasal inoculation with living virus, they are immune to all strains if the immunizing dose has produced a lesion in the lung; their antibody is still only to the homologous strain. If the immunizing dose has not produced a lesion, the mice have neither immunity nor antibody.

OBITUARIES

Sir Edwin John Butler, C.M.G., C.I.E., F.R.S.

EDWIN JOHN BUTLER was born on August 13, 1874, in County Clare, Ireland, and was educated at Queen's College (now the University College), Cork. He was senior scholar in 1896. In 1898 he took the M.B. (Hons.) at the Royal University, Ireland, but never practised. During 1899 and 1900 he held a travelling scholarship and worked at Paris, Freiburg, Antibes, and Kew. In 1901 he arrived at Calcutta as the first cryptogamic botanist to the Government of India; in 1902 was transferred to Dehra Dun, and in 1905 as Imperial mycologist to Pusa, the site of the new Agricultural Research Institute. In 1919 he became the joint director, and in 1920 agricultura

adviser to the Government of India. The same year he returned to England as director of the Imperial Bureau of Mycology; and in 1921, his services to India were recognized with the C.I.E.

While still in Europe, Butler had commenced his study of the genus Pythium, and became an adept at isolating its species from the soil; his monograph on the genus was published in India in 1907, and is still in great demand. His special interest in the Phycomycetes, for example, Phytophthora, Sclerospora, and Rhizophagus remained to the end. At Calcutta he was introduced to the fungi of the agricultural crops; at Dehra Dun to the forest fungi, especially as they attack tree roots, and at Pusa finally became committed to crop fungi, which were then poorly known. A ubiquitous weed *Launœa asplenifolia* was a reputed alternate host for Indian brown rust of wheat; its rust, however, proved to be autœcious, and *Puccinia butleri* Sydow commemorates one of his first tasks. Monographs on sugar-cane diseases, wheat rusts (with Hayman), Fusarium wilts, Sclerospora disease, and rice diseases, including one caused by an eelworm, were among his special publications. Five papers on the micro-fungi of India, jointly with H. and P. Sydow, covered the Indian rusts, smuts, Phycomycetes, Ascomycetes, and Cœlomycetes, many new records being based upon his own collections. In 1918, with the publication of his "Fungi and Disease in Plants", he established an international reputation as a plant pathologist. To round off his work on Indian mycology, in 1932 he published, jointly with G. R. Bisby, "The Fungi of India", a compilation of the species recorded up to 1930, and of their literature.

The year 1921 was mainly spent in organizing the new Bureau; but during a two months visit to America, Butler established cordial relationships with numerous mycologists and plant pathologists, and secured their goodwill for his new venture. In January 1922, he brought out the first monthly part of the *Review of Applied Mycology*, and for many years, editing that journal had the first call upon his time. In 1923 he visited New Zealand on his way to attend the Pan-Pacific Science Congress in Australia, and again secured the goodwill of all he met; the recognition of *Phytophthora hibernalis* Carne as a distinct pathogen of citrus dates from that visit. In 1924 he successfully organized the first Imperial Mycological Conference. In 1926 he was elected F.R.S., and was chairman of the Mycological Section of the International Congress of Plant Sciences at Ithaca, U.S.A. In 1927 he was president of the British Mycological Society, and was invited to Nyasaland to inspect the tea plantations there; *Sclerospora butleri* Weston, the type of which he collected, felicitously commemorates this visit. In 1928–29 he was president of the Association of Economic Biologists, and in 1929, the year of the second Imperial Mycological Conference, was also vice-president of the Linnean Society of London. In 1930, he was recorder of the Section for Mycology and Plant Pathology at the International Botanical Conference at Cambridge. In 1931 he was invited to the Sudan, where 200,000 acres of cotton were threatened by black-arm; in 1932 he was awarded C.M.G.; in 1934 was elected to the Council of the Royal Society; and delivered the Lowell Lectures at Harvard University, the home of the famous Farlow Herbarium and Cryptogamic Laboratories.

During this period, Butler's published work was mainly for the occasion, and displayed his many interests. In 1926 at Ithaca, for example, his subject was the delimitation of fungus species; in 1927 the development of economic mycology in the Empire; in 1929 the morbid anatomy of plants; in 1932, to the British Association, tropical plant diseases with "every gradation of severity from the sorghum smut which levies a moderate toll of about ten per cent of the crop . . . to the Panama disease which completely exterminates the susceptible bananas and precludes replanting within any reasonable time". But through it all, his spontaneous interest in fungi as fungi, together with his genial hospitality, attracted to the Institute all sorts and conditions of mycologists. Thus in 1934 A. H. R. Buller dedicated the sixth volume of his "Researches on Fungi" to "E. J. Butler, the distinguished director of the Imperial Mycological Institute, in recognition of his contributions to our knowledge of fungi, and of his helpfulness to fellow workers".

His years of service were marked by his pre-eminent ability both to appreciate a situation and to state a case. Hence his advice was in constant demand in committee work both by such Government bodies as the Colonial Advisory Council of Agriculture, and such public ones as the Empire Cotton Growing Corporation. Finally, in 1935, he yielded to insistent pressure, and left the Imperial Mycological Institute, where he will long be remembered as a great chief, and became secretary to the Agricultural Research Council. In 1938 he was made LL.D. *honoris causa* of the University of Aberdeen. He was knighted in 1939 and retired for health reasons in 1941. Just before his death, he was back among the fungi again, exuberantly rewriting for a new book the first chapter of his "Fungi and Disease in Plants" in the light of the experience of another quarter of a century.

He died suddenly on April 4, following an attack of influenza: and is survived by Lady Butler, and by a son and two daughters. E. W. MASON.

Commander F. A. Worsley, D.S.O., O.B.E., R.N.R.

COMMANDER WORSLEY was born at Akaroa, New Zealand, in 1872, and died at Claygate, Surrey, in February last. At fifteen years of age he was apprenticed in sailing ships of the New Zealand Shipping Company and made his first voyage in the square-rigged *Wairoa*. After his apprenticeship days, he became mate and later master of New Zealand Government schooners, among them the *Tutanaki* and the *Countess of Ranfurly*, working in the South Pacific. Afterwards he turned his attention to steam, joined the Royal Naval Reserve and had the usual training with the Grand Fleet. This was in 1908. In January 1909 he joined the Allan Line and made acquaintance during the succeeding five years with ice conditions on the Canadian route.

Worsley was appointed master of the *Endurance* in June 1914, and his abilities and untiring energy soon made themselves known. He was a splendid shipmaster and made an ideal combination with Shackleton. The *Endurance* was crushed in the ice after her adventurous voyage through the ice of the Weddell Sea and the crew then lived for six months on drifting pack-ice, until it broke up in the open sea east of Graham Land. Boats were launched and Worsley was in charge of the cutter *Dudley Docker* in the escape from the ice to Elephant Island. His outstanding feat was the navigation of the *James*