only for secret *ad hoc* undertakings under government, but also for the ends of private profit and sometimes for purposes which he cannot, in his heart, approve. If his liberty and his right to communicate or publish are restricted by an employer, he must deny a part of his already accepted ethical code. If he is party to the production of over-costly materials which should benefit the whole community, he must deny the humanist morality now required of him.

So powerful, however, is the position of men of science to-day and so considerably has their prognostic ability increased, that they could become, in some measure, the conscience as well as the technical advisors of the State. In the face of a concerted declaration of rights, the exploitation of those younger men of science who cannot find a place in academic work and whose skills could, under just conditions, be usefully employed, would be made at once more difficult and eventually impossible.

In a more positive sense, right actions in a social regard could be more frequently sponsored by the authoritative pronouncements of important scientific groups. Social responsibility should to-day extend to the effective instruction of the community and of central, local or colonial governments whenever policies touching the public weal are in question and especially when full scientific support for a particular beneficent policy is forthcoming. Here, for example, medical science could already make a larger contribution. Nutritional physiology had for some time established the basic human requirements, and yet it took a world war to ensure for the working people of Great Britain an equitable distribution of necessary foods. We still accept in England an annual death-roll of between one and two thousand children from bovine tuberculosis and much other sickness and disability due to contaminated milk. The occasional protests and individual writings of physicians and hygienists have been educationally insufficient to counter ill-informed opinion and to secure necessary legislation for the universal pasteurization of milk for human use.

The full responsibilities of the science teacher to his students also call for thoughtful revision. The late Prof. J. S. Haldane, in his Gifford Lectures (1928), concluded an argument concerning the fundamental character of psychological or humanistic knowledge with the following sentence: "It follows that the basis of a sound education must be humanistic, and that even the teaching of abstract sciences such as mathematics or physics should, through the history of these sciences or in other ways, be connected with human interest".

Seventeen years later an alliance of science and humanism in the teaching of our schools and universities has become more than ever necessary.

Ethical ideas and practice, phenomena peculiar to human societies, will in due course be themselves subjected to more intimate and scientific study, as we have been lately reminded by Julian Huxley in his Romanes Lecture (1943), by Waddington and others. But in the meantime we have evidence on certain major issues which compels us to assume right of judgment. Moral thinking and teaching are not a prerogative of the philosopher and the theologian. Nor can they thrive in dissociation from other specific intellectual activities. Fundamental physical studies and humanistic studies can no longer proceed safely in complete separation. The Good, as well as the True, has become a necessary objective of all science.

OBITUARIES

Prof. N. I. Vavilov, For.Mem.R.S.

NEWS has recently been received of the death in the Soviet Union of Nikolai Ivanovich Vavilov. The circumstances are not precisely known, but the time was after December 1941 and the place probably Saratov.

Vavilov was born in 1885 and was the son of a textile manufacturer. His sister was a medical woman and died of typhus during the First World War. His brother is a physicist and is now president of the U.S.S.R. Academy of Sciences. He had two sons.

In 1913 and 1914 Vavilov worked with Bateson at the newly established John Innes Horticultural Institution. There he published a paper revealing one of the main lines his thought was to follow: "Immunity to Fungous Diseases as a Physiological Test in Genetics and Systematics exemplified in Cereals" (*J. Genet*, **4**, 49–65). His idea was Darwinian, but its development was genetic in the modern sense. Its novelty depended on his taking the practical problem of host and disease as seen by the pathologist, and turning it upside down.

Vavilov returned to Moscow in August 1914, not without mishap. His valuable experimental materials were lost with the S.S. *Runo*, which struck a mine on the voyage home. During the War, he began the second of the important lines of his life's work—namely, exploration for cultivated plants. He visited Persia and the surrounding countries in 1916, principally in search of the cereals, the systematic relationships of which he had already examined experimentally.

In 1917 he went as professor of agriculture, botany and genetics to Saratov. Here he wrote the paper which provides the third line in the origin of the new methods combining systematics and genetics which he was to adopt, "The Law of Homologous Series in Variation" (*J. Genet.*, **12**, 47–89). Finally, in 1921, he was picked by Lenin for a post of unexampled opportunity. He found himself, at the age of thirty-six, president of the Lenin Academy of Agricultural Sciences and director of the Institute of Applied Botany.

Inspired by his own enthusiasm, and by Lenin's determined policy, Vavilov set up more than four hundred research institutes and experimental stations in the course of a few years. Several of these had as many as two hundred research workers, and the total number of their staffs in 1934 amounted to 20,000. His journal, the *Bulletin of Applied Botany, Genetics and Plant Breeding*, with its comprehensive surveys and its numerous supplements, became a leading international organ of publication in its field.

In these days it was a remarkable sight to see Vavilov at work in what he now called the Institute of Plant Industry, the palace which he had converted to his use. Here he would be, in his shirt sleeves, sprawled over a map of the Soviet Union covering the floor of his office, busy distributing and arranging his staff and stations. No less remarkable was the experience of flying with him from one to another and watching his vigorous, confident and cheerful handling of the machinery he had created and of the people who were working it. Wherever he went he took sunshine and courage. Nicolas III (as he playfully called himself in contrast to the statue across the road) certainly got things done.

In spite of these vast administrative duties, Vavilov found time to direct the precise scientific methods to be followed in his institutes, especially in regard to economic botany and the question of immunity to disease in plants. He set to work to make thorough collections of varieties of economic plants over the whole of their ecological range. These were to be the raw materials for synthesizing new types for specialized regions. During the years 1923–31 he organized and carried out, often alone, a series of expeditions to what he regarded as the important economic plant regions of the world—to Afghanistan, Abyssinia, China, Central and South America—to collect material of all economic plants of interest to the Soviet Union. As an example of the scale on which the work was planned, no less than 26,000 varieties of wheat alone were obtained and kept in cultivation at Leningrad. At the same time he made the Soviet Union itself the chief ground for similar studies of the origin and distribution of varieties of livestock, horses, cattle, reindeer, and so on.

These collections were also to be the raw materials of new theories, theories on the origins of cultivated plants which he set out at the Fifth International Genetics Congress at Berlin in 1927, and later embodied in his "Theoretical Bases of Plant Breeding" (1935, Russian text). His crucial idea was derived from plant systematics. It was that the geographical centre from which a species of cultivated plant spread was marked by the greatest genetic diversity and also the greatest concentration of dominant genes. The meaning and validity of this contention have been disputed on both special and general grounds. Its value, however, was, and remains, in its effect in making possible the combined and rigorous systematic and genetic (including, of course, cytological) treatment of variation within species of cultivated plants. In theory, Vavilov marked the first great advance on De Candolle; and in practice he laid the foundations of all future improvement of crop plants. His own potato collection, for example, led to the establishment of the British Empire Potato Collection on which potato breeding is now being based in Britain and elsewhere.

Vavilov himself led the expeditions to Abyssinia and South America. The Abyssinian expedition was his first. It was economical; Lenin allocated to it the small grant of £1,000. It was also arduous; for six weeks in the mountains Vavilov did not remove his overcoat. He ate native food, slept on the floor of native huts and most of the time he suffered from typhoid or dysentery.

His unsleeping mind, his untiring body, his ambitious plans, even his flamboyant showmanship, were all Napoleonic in character. But his intellectual integrity was never in doubt. Whenever he met another man of science for the first time he would ask, "What is your philosophy ?" In other words, "How do you approach your problems ?" Vavilov himself approached his problems in a spirit of perpetually youthful inquiry and optimism, never forgetting however, as he used to say, that "Life is short". His attitude is well illustrated by a quotation from his last publication (in "The New Systematics", Oxford, 1940). "We are now," he writes, "entering an epoch of differential ecological, physiological, and genetic classification. It is an immense work. The ocean of knowledge is practically untouched by biologists. It requires the joint labours of many different specialists—physiologists, cytologists, geneticists, systematists, and biochemists. It requires the international spirit, the co-operative work of investigators throughout the whole world. . . . We do not doubt that the new systematics will bring us to a new and better understanding of evolution, to a great increase in the possibilities of governing the processes of evolution, and to great improvement in our cultivated plants and domestic breeds of animals. It will bring us logically to the next step; integration and synthesis."

Already, however, after the notorious genetics controversy at the end of 1939, from which the Lysenko school emerged successful, Vavilov had apparently lost his executive positions, and, in spite of many attempts, his friends failed to communicate with him. His work and his workers seemed to fade away; and, when Leningrad came to be besieged, the residue of his collections was eaten by the famished people. But though, in later years, he was thought little of by the Soviet authorities his fame abroad steadily increased. He was asked to be president of the International Congress of Genetics in 1939—an honour which he had to renounce, after first accepting, when the Russians decided to take no part in the Congress. In 1942 he was elected a foreign member of the Royal Society.

Vavilov spent all his life collecting and observing and arranging facts and ideas, many of them outside the field of science. In his travels he was helped by being a good linguist. With the same enthusiasm with which he studied their agriculture, he followed the customs, the music and the arts of the peoples he journeyed among. Physically he was of stocky build and dark complexion, with a Tartar cast of countenance. A host of friends in Europe and America will lament his death. They are not likely to forget his Robesonian depth of voice, his Falstaffian breadth of gesture. But science at large will remember his achievement, an achievement that survives his personal disaster.

S. C. Harland.
C. D. Darlington.

Dr. L. A. Borradaile

Lancelot Alexander Borradaile, who died in hospital on October 20, aged seventy-three, was known to most medical and zoological students of the last twenty-five years. Wherever English is spoken, he was the author of their first text-book, "Manual of Zoology", and a shortened form when medical examinations became more strenuous. He was the son of a city merchant in the African trade whose family came from the Lake District. Educated at Blackheath and Felsted, he entered Selwyn College, Cambridge, receiving a scholarship in 1893 when he obtained a first class in the Natural Sciences Tripos, a feat repeated in Part II, 1894, in spite of poor health which prevented his taking part in games; this caused a certain neglect in his schools and he became shy, which in his social life greatly hindered him.

In 1895, Borradaile commenced to demonstrate in the Zoological Laboratory, Cambridge, where he worked under Bateson on the variation in Crustacea. In 1899 he accompanied me round the coasts of Ceylon and to Minikoi; he had already studied Willey's Stomatopoda and discovered the marine development of the coco-nut crab. In the tropics he settled down to work on the biology, physiology and anatomy of land Crustacea, now regarded as a classical research. This was followed by his thoughts