kept apart, and in the third experiment these qualities were also rated in the same way. In the first experiment, forty women and eight men took part, and twelve chords were rated, each in six different settings and by itself. In the second, forty-three women and seven men rated fourteen chords in all of which the actual notes were identical. They were in settings mostly taken from familiar pieces of music. In the third, forty women and ten men rated fourteen chords in all of which the notes were identical, and which were in settings specially constructed for the experiment. The piano was the instrument used throughout. In the first experiment 'clang' effects were exploited, and in the other two interest was concentrated upon the musical preparation and resolution of dissonances.

It was found that familiar dissonances were given all kinds of ratings from very consonant to very dissonant, but most often they were classed as moderately dissonant, a seventh being classed on the average as less dissonant than a ninth, so that the average results were appropriate to musical expectation. There was a strong tendency for the consonance-dissonance level of chords to vary (a) with the context and (b) with the individual subjects' peculiarities of musical attitude and experience. Nevertheless, the chords had a strong tendency to retain their relative dissonance-levels in spite of these variations. There was a moderate tendency for liking to go with the impression of consonance, and disliking with that of dissonance. Smooth musical handling of dissonances tended to lead to the impression of consonance and also to liking, but departure from smooth handling led to various other combinations of liking, disliking, consonance and dissonance. The subjects were always astonished when told that they had rated the same note-combinations in different settings.

Helmholtz's theory of fusion appeared to provide the most satisfactory explanation of consonance and dissonance, apart from the effects of musical setting and individual attitudes of listeners. A Gestalt or 'form' theory of the effect upon the dissonance-consonance level of individual chords owing to their integral membership of whole passages or contexts should be added, together with a theory of personal schemata due to differences in musical ability and experience of individual listeners. Further experiments should be carried out on the relative effects of various musical techniques in handling dissonances and of 'clang' effects upon dissonance-consonance levels, and to compare these effects for pure tones and notes of complex timbre.

The third contribution to the symposium was made by Mr. J. Stuart Wilson. He pointed out that there are unfortunate tendencies at present to exploit the performer's capacity to vary the intonation of the intervals he sang or played. This is particularly noticeable in 'jazz' and 'swing', in which it has become an objectionable form of virtuosity. Even among serious musicians, some teachers trained their pupils to vary the intonation in playing classical music to produce special effects. Sometimes this had unfortunate results, because of the variety of thirds, for example, which might be included in a major common chord played by an orchestra. In addition, the liberties taken in 'jazz' and 'swing' had taught the public to like some effects which classical musicians eschewed, with the result that they thought that serious music was intolerably dull when it was really well played.

In the discussion the main speakers agreed that slight adaptations of pitch to suit the musical needs of a passage might be justified, provided that this did not lead to intolerably slovenly performance or to a form of senseless virtuosity. They also agreed that the impression of harshness of a dissonance might be expected to vary according to the way in which it was used. Mr. Stuart Wilson thought it most unfortunate that so many peoples' ideas of musical intervals came from listening to the pianoforte, which was often badly tuned either because nobody looked after it or because there was none to criticize the work of the tuner.

Dr. Dennis Fry pointed out that many people with absolute pitch are able to assign pitch to a sound which, for the majority, seems to be a noise without definite pitch. He asked whether people with absolute pitch might have two abilities, possibly separate in some cases: first, the permanent memory for pitch enabling them to compare pitches without reference to an external standard; and second, the ability to assign pitch to a frequency complex containing strong inharmonic components. In reply, Prof. van der Pol said that it is easier for most persons who have absolute pitch to assign pitches to notes which have many overtones than to pure single tones.

Dr. Fry asked whether the pitch of a given tone of fairly low frequency, say Middle C, 261 c./s., is recognized by a person with absolute pitch regardless of its intensity. If not, then at what intensity-level would it become Middle C? Also he thought it would be interesting to know what loudness-level of a pure tone of 261 c./s. gives rise to a pitch sensation exactly equal to that of a frequency complex containing a number of terms with a constant difference of 261 c./s. between them. Prof. van der Pol demonstrated the effect of varying the intensity of a given tone with his oscillator, but did not think data were available for answering the questions asked by Dr. Fry. It was suggested by Dr. Pickford that a valuable piece of research could be carried out in which adequate psychological experiments were performed with a large group of persons having various degrees of absolute pitch, in order to find out more about its variations among individuals, which might be very great. He also suggested that the euphonic value of an interval or chord, as defined by Euler, did not in itself determine the dissonance level of that chord. The only way to determine the euphonic value which would correspond to dissonance rather than to consonance would be to study the average of individual judgments and their variability. Most people would think that a euphonic value of 8 was dissonant; but the only way to determine this would be that of experimenting with large numbers of subjects.

R. W. PICKFORD

OBITUARIES

Prof. M. C. Potter

At the age of eighty-nine, Emeritus Professor the Rev. Michael Cressé Potter died on March 9 at New Milton, Hampshire, where he had lived since his retirement in 1925 from the chair of botany at Armstrong College (now King's College), Newcastle upon Tyne.

In 1877, Potter left the Perse School, Cambridge, and entered Peterhouse, where his father, who was

rector of Corley, had preceded him and his uncle, the Rev. Canon Potter, had been a fellow. As, in addition, another uncle, Prof. Richard Potter, was a fellow of Queens', Potter rightly regarded himself as a well-established Cambridge man. He was ardent in support of his University on all public occasions. As an undergraduate he read natural science and graduated in 1881. He then read for the Mathematical Tripos, and in 1883 was classed senior optime. Shortly afterwards he was appointed to the post of assistant curator of the Herbarium under Prof. C. C. Babington, which became vacant through the tragic death by drowning of T. H. Corry. He assisted Dr. Walter Gardiner in re-establishing the University Botanical Museum, which had been founded by Prof. Henslow, and in commencing the preservation of botanical specimens in spirit.

Potter began his academic work when what was then known as the 'new botany', introduced by McNab at Dublin and by Huxley and Dyer at South Kensington, was coming to the fore, and when practical laboratory investigation was being developed at Cambridge under the direction of the reader, S. H. Vines. He stressed the new ideas, and the economic importance of plants, in the long-vacation course of lectures he gave on systematic botany, and he arranged excursions and laboratory work. He delivered the first course of lectures given at Cambridge on the geographical distribution of plants. On two occasions he was awarded a Wort's travelling scholarship. In 1886 he went to Portugal and made observations on an alga which lived parasitically on the carapace of the water tortoise. In 1888-89 he studied the tropical flora in Ceylon.

In addition to these travels, Potter went to Heidelberg and attended Prof. Pfister's lectures there. He thus became familiar with the Continental system of classification, and used it in his lectures on systematic botany. In 1894 he translated and edited Dr. E. Warming's "*Handbog i den Systematiske Botanik*" in order to introduce this system to English-speaking botanists.

In 1889, after six years of rich experience, Potter took up a lectureship in botany and biology at Newcastle upon Tyne. In his first term there were only five students in natural history, none reading for a degree. In 1892 a chair was instituted, and Potter was its first occupant. Potter, who could be a determined man, eventually won his uphill fight to secure the recognition of botany as an independent subject at the intermediate and final pass and honours degree examinations. A measure of the success with which he built is the fact that on his retirement from the chair in 1925 he had four lecturers on his staff, and his department, which was fairly well equipped, could accommodate in reasonable comfort the 167 students of pure science, agriculture and medicine who were then attending courses in it.

The link between the Departments of Botany and Agriculture has always been strong. Potter did much in establishing it. The content of his course for agricultural students is indicated by that of his elementary "*Text-book of Agricultural Botany*", which was published in 1893. He also took evening classes for farmers and gardeners. He became interested in problems of plant pathology, and his researches culminated in the major discovery in 1899 that white-rot of turnips is caused by a bacterium, which he named *Pseudomonas destructans*. In his presidential address to the British Mycological Society in 1909 he gave the evidence that led to the

recognition of bacterial diseases of plants, and placed his contribution in its historical setting. His interest in plant pathology and economic mycology was maintained throughout his life, and the subject received much attention in the curriculum he devised for students in science and in agriculture at Newcastle.

As a teacher and examiner, Potter laid great emphasis on experimental physiology. From 1895 (the date of publication of Darwin and Acton's book) onwards, students carried out experiments, even in the elementary agricultural and medical classes and examinations. Potter believed that, in those early days, the University of Durham's schools examination was unique in requiring a practical examination in botany in which each candidate was required to set up and explain a simple experiment and to determine a plant by means of a flora.

Some may regret that after 1910 his main research interest was transferred from plant pathology to electrophysiology, through his reading Dr. A. D. Waller's "*Signs of Life*". Physicists who knew about his work thought that such effects as he obtained were open to interpretations other than those he put on them. He held tenaciously to the idea that electrical effects accompany metabolism and are of primary importance in determining cellular activity. He may have been right. Who knows?

During the First World War Potter showed his ardour by acting for a period as a volunteer in a Newcastle signalling unit raised for home defence, and later by taking Holy orders to relieve younger clergymen required by the Forces. Among his hobbies were campanology and dowsing.

M. THOMAS

Prof. E. Waymouth Reid, F.R.S.

THE death of Prof. E. Waymouth Reid in Edinburgh on March 10 has taken from us one of the pioneers of British physiology. Born in 1863 in Canterbury, the son of a surgeon, he was educated in Sutton Valence Grammar School, and went as a classical scholar to the University of Cambridge. After taking a first-class in anatomy and physiology in the Natural Sciences Tripos in 1883, Waymouth Reid worked in St. Bartholomew's Hospital, and graduated M.B. Thereafter he was for a time assistant electrician in St. Bartholomew's, but soon began his life's work as a physiologist, first as demonstrator and then as lecturer in St. Mary's Hospital Medical School. At the early age of twenty-seven he was appointed to the newly established chair of physiology in University College, Dundee, where he joined a body of highly gifted men who held teaching posts in the recently formed College affiliated to the University of St. Andrews. Waymouth Reid served the University for forty-six years, and after his retirement in 1935 the University of St. Andrews conferred upon him an honorary degree of LL.D.

Waymouth Reid showed his ability in the number and versatility of the published records of his research work. He contributed in 1898 noteworthy articles to Schäfer's "*Text-book of Physiology*" on diffusion, osmosis and filtration, and on secretion and absorption by the skin; and papers in journals on a diversity of topics. He was made a fellow of the Royal Society in 1889, and later on received the honorary degree of Sc.D. from the University of Cambridge.

Waymouth Reid was especially interested in the physical mechanisms of living processes and kept in touch with modern developments. He was an early