investigators, and is for electrons of the same speed. The difference is that the diffracting material is, in this case, a thin lamina of mica. Patterns of this type were produced first by Kikuchi in Japan, and for some time there was no satisfactory explanation of them. The diffracting system is a single crystal; the electrons are homogeneous in speed, the waves are monochromatic. Now it is well known to those familiar with the theory of X-ray diffraction that in general no pattern is produced when a beam of monochromatic waves traverses a single stationary crystal. One or two diffraction beams may possibly appear, but if so the event will be fortuitous; in general no beams will be observed other than the directly transmitted primary beam. Kikuchi should have known better than to make this experiment, but he did make it, and this pattern by Drs. Eisenhut and Kaupp is a beautiful example of the result he obtained. What appears to be the correct explanation of the production of this pattern has been given us recently by W. L. Bragg in England and independently by S. B. Hendricks in Washington. Bragg and Hendricks assume that the mica crystal is to a certain extent a crystal aggregate—not an aggregate of crystals oriented at random as in the case of the film of silver, but an aggregate of tiny flakes which fail to form a perfect crystal only by being tilted slightly this way and that. This assumption together with the excessively short wave-length of the high-speed electrons employed in these experiments is sufficient to explain the production of this pattern. It turns out to be, to a close approximation, the pattern which would be produced if the diffracting systems were a single layer of molecules instead of some hundreds of layers as it actually is. These patterns also are available for calculating electron wave-lengths, and again the agreement with the de Broglie formula is as nearly perfect as can be expected.

These three phenomena which I have described, the regular reflection of electrons from a crystal surface, the diffraction of electrons by an aggregate of small crystals of silver and the diffraction by mica, illustrate the circumstances in which it is convenient to regard electrons as waves rather than as particles. Whether or not it is possible to achieve a unified conception of electrons in which these newly discovered wave properties appear consistent with their longer known corpuscular properties, or whether such an achievement is beyond the limits of thought, is a question which does not worry the experimental physicist a great deal. It used to be said that a physicist regards light as a wave phenomenon on Mondays, Wednesdays and Fridays, and as a corpuscular phenomenon on the other days of the week. This statement must now be extended to include electrons, and modified, I think, to state that he regards light and electrons as both waves and particles on all days of the week. And it might be added that familiarity with this idea is dulling his sense to its paradoxical nature.

IN HONOR OF DR. WELCH[1]

I INTENDED to throw away my manuscript, but I find that I can hardly trust myself to speak without it. I must speak in my own person and not in that of the idealized figure which has been presented to you.

It is quite beyond my power of words to express the thoughts and the feelings of gratitude which this wonderful occasion has aroused in me. Did I accept merely as a personal tribute these words of praise and this manifestation of appreciation and good-will marked by this large and distinguished gathering and by meetings elsewhere, I should be overpowered with a sense of unreality depriving me of utterance, but I shall assume, as I feel that I am justified in doing, that, by virtue of certain pioneering work and through over a half century of service, I stand here to represent an army of teachers, investigators, pupils, associates and colleagues, whose work and contributions during this period have advanced the science and art of medicine and public health to the eminent position which they now hold in this country.

It is, then, in this representative capacity, as well as personally, that, first of all, I express to you, Mr. President, immeasurable gratitude for the distinction which you lend to this occasion by your presence and active participation. You will permit me to add, Sir, that your presence and generous words of appreciation have a significance not measured solely by the high office which you hold, for you speak with the authority of one who has made memorable and outstanding contributions not only to this nation but to the whole world in the field of public health and social service, especially to the most appealing part of this domain, the health and welfare of infants and children.

And to you, President Farrand, and to you, my old friend and pupil, Dr. Flexner, who have spoken here so eloquently, even if in words all too generous so far

[1] Response of Dr. William Henry Welch, delivered in Memorial Continental Hall, Washington, D. C., at the ceremonies celebrating his eightieth birthday, April 8, 1930. The address of President Hoover was printed in the issue of SCIENCE for April 18, p. 411.

as I, personally, am concerned, to Mr. Kingsbury and the other distinguished members of the committees which have arranged this marvelous occasion, to the many citizens, also to the medical officers of the Army, Navy and Public Health Service, members of my profession here gathered, who honor me by their presence, my debt of gratitude is beyond words to express. If my voice carries to an invisible audience, to personal friends and to other gatherings in honor of my eightieth birthday and what it may symbolize, it conveys appreciation and greetings which come straight from my heart.

While I have been kept in ignorance of the details of these ceremonies, I have been cognizant that the immediate occasion was to be the presentation to me of Mr. Hutty's etching, which, I am sure, in spite of the handicap presented by the subject, he has made a work of art. This I am delighted to accept, and I am still more rejoiced that so many selected institutions and organizations with many of which I have been connected are to receive it.

If it is true, as I have been told, that there are gatherings of friends and colleagues in many places, not only in this country but also in other countries, who are interested in the event here celebrated, I only wish that the time allotted permitted me to tell them —my friends in Germany, whence came my early training and inspiration in pathology and bacteriology, my friends and colleagues in Paris, especially those at the Pasteur Institute, and those in London, Tokyo, Peking and elsewhere—to tell them how much pleasure and satisfaction and inspiration I have derived from their friendship and association. To the favor and support and cooperation of the members of my profession I owe whatever success I have attained.

No one could have been more favored in his professional career by time and opportunity, and by the good work, achievements and cooperation of pupils, assistants and associates, than I have been.

Born only three and a half years after the introduction of surgical anesthesia, I entered upon my professional career in the middle seventies of the last century, before Lister had really triumphed by the general adoption of the principles of antiseptic surgery and just before the demonstration by Pasteur and by Koch of the causation of infectious diseases by microscopic germs. I returned from Germany, thrilled with enthusiasm, at the dawn of the new era, and with some training and capacity to use that master key forged by pathology and bacteriology, which was to unlock secrets of nature destined to transform the face of modern medicine.

Since that time the fundamental achievement which has made possible the remarkable development of scientific medicine in this country during the last four decades has been the great improvement in medical education, with the accompanying creation of laboratories for instruction and research. So brilliant have been the results in discoveries and their application to the treatment and prevention of disease that one is likely to lose sight of the foundation upon which the stately superstructure rests.

Only those can realize the magnitude of this achievement who know something of the condition of medical education in this country fifty years ago, when no one dreamed of endowing medical education and research, in contrast with the condition to-day, when these subjects, together with utilization of opportunities to further and to apply the new knowledge, constitute the most favored and rewarding fields of private and public philanthropy.

I like to think that the primitive little laboratory which I started in 1878 at the Bellevue Hospital Medical College and that of Dr. Prudden, inaugurated almost simultaneously at the College of Physicians and Surgeons of Columbia University, and especially our effort to meet a much larger opportunity, at that time unique in this country, at the Johns Hopkins University and Hospital four decades ago, were not without influence in the improvement of medical education. But the accomplishment would not have acquired the national importance which it has assumed without the participation of other medical schools in the forward movement, the awakening of the medical profession through the American Medical Association and the state licensing boards, and the recognition of the great foundations, first and most important of all, the Rockefeller General Education Board, of the needs and opportunities of the situation.

If I have handed on any intellectual heritage to pupils, assistants and associates, whose work and achievements have been the greatest satisfaction and joy of my life, it is derived from that which I received from my own masters, Cohnheim, Robert Koch, Weigert and others. America is now paying the debt which she has owed so long to the Old World by her own active and fruitful participation in scientific discovery and the advancement of the science and art of medicine and sanitation.

The greatest triumphs of modern medicine have been in the prevention of disease, although the physician's power to alleviate and to heal has also been greatly enhanced. It is perhaps not too much to claim that America has taken a position of leadership in the application of the new knowledge to the prevention of disease and to personal and public hygiene.

But, my friends and hearers, it is my inclination, even at four score years, to look forward, rather than

backward, and to avoid a feeling of self-complacency through the rehearsal of past triumphs. All along the line, in the fields of medical education and research, in the study and treatment of disease and injury, in the preservation and improvement of health and the prevention of disease, so much more remains to be done than has been accomplished, the problems awaiting solution are so numerous and pressing, above all, the better utilization of existing knowledge and the need of more knowledge are so obvious and so urgent that our mental attitude should be far removed from satisfaction with existing conditions.

While public health is the foundation of the happiness and prosperity of the people and its promotion is recognized as an important function of government, how wide is the gap between what is achieved and what might be realized, how inadequate is the understanding of the public concerning the means adapted to secure the best results, how small the attractions offered to those entering or who might desire to enter careers in public health through lack of suitable financial recompense, of security of tenure of office, of opportunities for promotion, of standards for eligibility based upon special training and experience and of funds made available for the public promotion of health. Something of the lack of adjustment of the average man to rapidly changing social, economic and political conditions of our complicated modern civilization may be reflected in a certain temporary maladjustment between curative medicine and preventive medicine, which should stand in harmonious relations.

As my immediate and, doubtless, final professorial interest is on the humanistic side of medicine, I may, in closing, be permitted to emphasize the attractions and importance of studies in the history of medicine and of science. We physicians apply the word "humanism" to a period and to a spirit which released the mind from thraldom to authority and contributed mightily not merely to the study of classical antiquity but to the study of nature and of man, leading logically and rapidly to the cultivation of experimental science, between which and humanism, as we understand and use the word, there is no incompatibility whatever.

While nothing can be more hazardous than to attempt to predict the directions of future discovery and progress in the biological and medical sciences, it requires no prophetic gift to be confident that with the widening of the boundaries of knowledge will come increased power to relieve human suffering, to control disease, to improve health and thereby add to the sum of human happiness and well-being. Your presence on this occasion and the wide-spread recognition so conspicuously manifested of the value of services rendered in the field of medical education and medical science are an encouragement to teachers and workers for which I am profoundly grateful and which accentuates the note of hopefulness which I have endeavored to sound.

SCIENTIFIC EVENTS

THE ELECTION OF STATESMEN AS FELLOWS OF THE ROYAL SOCIETY[1]

THE president and council of the Royal Society have recommended Mr. Ramsay Macdonald and General J. C. Smuts for election into the society under the special statute which permits the election of "persons who in their opinion either have rendered conspicuous service to the cause of science, or are such that their election would be of signal benefit to the society." It should here be said that the inclusion of certain persons not actually engaged in scientific pursuits is a practice sanctioned by long usage. In the society's original statutes of 1663, it was provided that every one of His Majesty's subjects having the title and place of baron, or any other higher title or place, and every one of His Majesty's Privy Council, might be elected. In process of time, such persons formed a panel or privileged class. However, in 1873, there was much discussion on a motion to require in the privileged class, "evidence of ascertained special power and disposition to forward the aims of the society from exceptionally personal or official advantages of position." Arising therefrom, the privileged class was limited to princes of the blood royal and members of the Privy Council. Statutes enacted in 1902 abolished the clause relating to privy councillors and the basis of qualification remains now as quoted above. Its implications seem clear enough. The opportunities of the chief officer of state in the scientific arena are always at hand; they have nothing to do with political complexities.

In connection with Mr. Macdonald's nomination for election, it is interesting to recall that within the past sixty years four precedents can be recorded for the election of a Prime Minister whilst holding the seals of office. The instances are: Mr. Disraeli, elected on February 10, 1876; Mr. Gladstone, elected on January 13, 1881; Mr. Asquith, elected November 5, 1908; Mr. Baldwin, elected November 3, 1927. The first-named signed the charter book and was formally admitted by Dr. J. D. Hooker, the president, on June 1, 1876—fifty-four years ago—that also being the day fixed for the election of the fifteen ordinary fellows. Amongst

[1] From *Nature*.