

"αἰὲν ἀριστεύειν καὶ ὑπέροχον ἔμμεναι ἄλλων," often cited by the original of the medal.

A few notes follow, on a less well-known side of Sir William Lawrence's early work, from the pen of a distinguished pupil.

#### IN MEMORY OF LAWRENCE.

In the domain of surgery the name of Lawrence is held in high honour as that of a practitioner and observer of the utmost skill and originality. As a teacher at St. Bartholomew's Hospital and in the theatre of the College of Surgeons his services to the profession which he had adopted are recognised as having been invaluable. It is, however, not perhaps so well known that he was also a pioneer in those branches of research which more recently, under the direction of Darwin and Wallace, have effected such a revolution in our conceptions of the great scheme of zoological development. Not that it can be claimed for Sir William Lawrence that he anticipated the modern creed as to the descent of man, for he expressly repudiated the tenet of a common line of ancestry for man and brutes. Still, however, his lectures on the "Natural History of Man," delivered as professor to the Royal College of Surgeons, were far in advance of the opinions of the day, and were full of new thought and suggestion. They were published in 1816, and went through at least eight editions. Although now superseded by other works, they are still a mine of carefully collated facts to which the student refers with pleasure and profit. As is well known, they brought upon their author a storm of persecuting zeal, at the head of which was Abernethy, Lawrence's senior colleague at the hospital! In a second course of his college lectures Lawrence referred to these proceedings, and in a tone of manly independence claimed the right to think for himself and to express his opinions in his own terms. "These privileges, gentlemen, shall never be surrendered by me; I will not be set down nor cried down by any person, in any place, or under any pretext. However flattering it may be to my vanity to wear this gown, if it involves any sacrifice of independence, the smallest dereliction of the right to examine freely the subjects on which I address you, and to express fearlessly the result of my investigations, I would strip it off instantly." This was bold language in a young man, and one who in his profession was of course a candidate for public favour. It was indeed by this high endowment of moral courage that Lawrence was enabled to approach the topics which he treated of in a manner which was so far in advance of the current modes of thought, and so eminently advantageous to the age.

Lawrence's personal bearing was an index of his character. His stature was tall and his manner dignified, and his face was, in its expression of intellectual calm, one of the noblest ever worn by man.

JONATHAN HUTCHINSON.

#### JULIUS SACHS.

JULIUS SACHS<sup>1</sup> was born at Breslau October 2, 1832, and died at Würzburg on May 29, 1897. Although his health had been seriously impaired for years, his last illness was not of long duration. He was regularly at work in his laboratory during the Easter vacation, and only took to his bed about the middle of April. A few days before the end came, he sank into coma and died without pain. Of his early career I have not been able to learn anything: I remember to have heard him say that his first teacher was Purkinje, under whom he published two or three zoological and geological papers. His first official post was that of Privat-Docent at Prague. In 1858-59 he was at Tharandt, in 1860 at Chemnitz. In 1861-62 he was appointed Professor in the Landwirtschaftliche Institut at Poppelsdorf, near Bonn. In 1867 he was called to the chair of Botany in Freiburg, and in 1867 he obtained the professorship at Würzburg, which he held up to the time of his death.<sup>2</sup>

It is not easy for a botanist of these days to estimate the debt of gratitude that he owes to Sachs. We have

<sup>1</sup> I believe that Sachs never made use of the title of *von*, which was conferred upon him.

<sup>2</sup> For the above facts I am indebted to the kindness of Prof. Kunkel of Würzburg, and Prof. Marshall Ward.

grown up in the modern school, and we mistake for our natural environment a state of things which his labour of forty years painfully built up for us. There is a natural blindness of the child to the parent, or the apprentice to his master, and this we can only partially overcome.

The place of Sachs in the history of Botany is, I am inclined to think, even higher as a teacher than as a discoverer. He will be more permanently known for his "Experimental Physiologie" (1866), by his "Lehrbuch" (first edition, 1868),<sup>1</sup> his "Geschichte der Botanik" (1875),<sup>2</sup> and his "Vorlesungen" (1882),<sup>3</sup> than by his "Collected Papers" (1892-93). The earliest of these volumes, the "Experimental Physiologie," seems to me in some respects the best. If we compare it with previous books on the physiology of plants we feel an enormous advance, not only in the fire and vigour with which it is written, but especially in the absence of compilation; it reads like an original paper rather than a treatise, and it was in fact largely founded on the activity of twelve of the best years of his life. Between 1853, when his first paper appeared in the Czechish journal *Zizva*, until 1865, just before the publication of the "Experimental Physiologie," he published (according to the Royal Society's Catalogue) sixty-eight papers, of which, however, the two or three earliest ones were not botanical. The book gives internal evidence of being written with the delight of a strong man in his work, and Sachs has been heard to say that he wrote it with a pleasure greater than that given by any of his later books.

On the other hand he spoke, if I remember aright, somewhat wearily of the years of section-cutting and microscopy needed for his "Text-Book." This may serve to remind us of what we are apt to forget—the mass of original matter hidden in this admirable book. In his last book, the "Lectures" of 1882, he returned to what best suited his turn of mind—a broad, general view of physiology. At the same time he handed over the re-editing of the histology, the detailed morphology and classification in the "Text-Book," to his friend and pupil Goebel.<sup>4</sup>

The "Text-Book" has no doubt had a greater effect on botany than any one of his other books. The modern botanist is sometimes assumed to be ignorant of taxonomy, but a man who has worked practically through Sachs' "Text-Book" knows more of the classification of the vegetable kingdom as a whole, than the older botanist who knew the phanerogams minutely, but little beyond them. As a single proof of the fruits arising from a proper understanding of the taxonomy of plants, it may be pointed out that palaeobotany has only been rendered possible as a science by the sort of knowledge inculcated by Sachs. Witness the work of Solms Laubach and Nathorst and others on the continent, and of Scott and Seward in this country, as compared with the efforts of earlier workers. The effect of Sachs' "Text-Book" in England was intensified by the great revival of scientific teaching instituted by Huxley, in which the all-importance of practical work was insisted on. And thus the learner of those days had the good luck to be supplied with Sachs' "Text-Book" just when he was spurred on by his teacher and by the spirit of the times to examine the histology and physiology of plants for himself.

As a teacher in the laboratory Sachs' position was equally great. He was most generous in receiving pupils, and those of us who had the good fortune to be of that number must always remember with gratitude his genial welcome and the pains he took with us over our work. To some it was a first introduction to a research laboratory, to a region where, if examination is not quite

<sup>1</sup> The English translation of a later edition appeared in 1874, under the name of "Text-Book."

<sup>2</sup> English translation, 1890.

<sup>3</sup> English translation, 1887.

<sup>4</sup> English translation, under the title of "Outlines of Classification, &c.," 1887.

banished, it is so much in the background as to be forgotten. It was extraordinarily invigorating to fall into the midst of a group of young men each engaged in his problem, and ruled over by a kindly despot full of resource and enthusiasm, and both willing and able to give us questions to solve. His tendency was to do things in a broad, handsome manner. He liked to have a flush of material, and he sacrificed it royally; for instance, in his work on roots he used 3000 beans. He insisted on things being done in a sound, cleanly manner, and especially inculcated the proper cultivation of experimental material, often reproving his pupils if they did not give light enough to their plants. He liked the practical details of cultivation, and would take pleasure, for instance, in showing his pupils the proper way of moistening earth for germinating beans; with the remark that this ought not to be done by a gardener, and adding "Das macht mir Spass" as a further reason for doing it himself. He preferred simple methods and broad results, and was essentially a man of round numbers. He did not deal in elaborate apparatus, and had indeed a somewhat unreasonable dislike for "Sogenannte Genauigkeit." But this was rather the dislike of unnecessary exactness, or of exactness misplaced—a valuable point of view in an experimentalist. He had, however, a liking for mechanism, as his invention of the recording auxanometer and of the klinostat shows.

As a lecturer he was admirable, and illustrated his words on the blackboard with evident pleasure and in the most life-like of sketches.

His papers have been collected in two volumes, published in 1892-3, many of the researches having appeared in his celebrated "Arbeiten," three well-known volumes, in which it was the highest ambition of his pupils to obtain a place.

The main point that strikes one about his work is that his was pure rather than applied physiology; he cared for the behaviour of a plant as he cared for a machine, not in relation to its environment. He was essentially not a biologist in the modern sense, though, as a matter of fact, he was an evolutionist.

His work may be divided, as he has himself classified it, into the physiology of nutrition and that of movement. In both these departments he laboured incessantly, and made numerous important discoveries; yet, in spite of what he added by his admirable researches, it seems to me that he was even more remarkable for his power of strengthening and marshalling a subject, and of placing it before the world with a vigour and clearness that ensured its acceptance.

Thus, in regard to nutrition, he established, by the most brilliant of his researches, the connection between carbon-assimilation and the existence of starch in the chloroplasts; yet his fame seems to me to rest with even greater certainty on the fact that he saw more clearly than any modern botanist the overwhelming importance of a just view of assimilation, and that he had the intellectual force needed to drive it into the minds of a generation of botanists.

In the same way he marshalled, remodelled and largely added to our knowledge of growth and growth-curvatures, and set forth his results with a style and force that were irresistible. But the conception of stimulus and reaction, now the central principle of plant—as of animal—physiology, only came to him imperfectly, as it seems to me. His use of the word *anisotropic* for organs behaving differently in relation to the same cause, implies a certain want of perception of the heart of the matter. The word is not really wanted, since the conception of irritability postulates what he called anisotropy. The stimulus is but a sign-post; the needs of the plant in relation to its environment necessitate that different organs shall be guided by the stimulus in opposite directions.

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In spite of the strength and clearness of his way of thinking, there was in him a vein of something like mysticism, as, for instance, in his conception of a radial organ as corresponding to a dorsiventral organ rolled up like a scroll; or in his assumption of an invisible dorsiventrality in certain plagirotropic organs.

Again, there is in his views what strikes some of us as almost mediæval. For instance, his idea of the root-forming and shoot-forming material flowing in opposite directions, and thus accounting for the behaviour of cuttings. The same may be said of his views on etiolation, although in these days of the thyroid treatment of myxœdema it is rash to deny the feasibility of any explanation founded on the special nutrient value of definite substances. But it is juster to put aside these considerations, and in a broader spirit to remember only the masterly way in which, in his "Lectures" (1882), he developed the classification of organs into "root" and "shoot" into a system of physiological morphology, *i.e.* into a morphology which goes beyond phylogeny into the region of adaptation.

I have thought it right to speak plainly about Sachs' work, for I am assured that it contains so much of enduring value that it deserves the truth; and I willingly allow that in the points in which my estimate of this great man is less favourable than some of my contemporaries, I may be misled by that blindness of which I have already spoken.

In his later years his life was overshadowed by broken health, and his nature—sensitive and self-centred—was never compatible with a serene or happy life. Those who came under his influence must be glad to forget the less happy side of the picture, and remember with gratitude how much they owe to Sachs.

FRANCIS DARWIN.

#### PROFESSOR R. FRESENIUS.

CARL REMIGIUS FRESENIUS, whose death occurred last week, was born at Frankfurt-on-Main on December 28, 1818. After a preliminary training at a pharmacy in that town, he devoted himself to the study of natural science, more especially of chemistry and botany. In 1840 he entered the University of Bonn, but a year later went to Giessen, where Liebig chose him as assistant in his laboratory. He graduated at Giessen in 1843. In 1845 he was called to the professorship of chemistry, physics, and technology at the Agricultural Institute at Wiesbaden, with which he has since been identified. The chemical laboratory at Wiesbaden, founded, owing to his exertions, in 1848 by the Government of the Duchy of Nassau, has since been much enlarged, a school of pharmacy being added in 1862, and a research laboratory for agricultural chemistry in 1868. The direction of the latter was taken over by his son, Dr. Henry Fresenius, in 1881. Fresenius received the title of Geheim Rath of the Duchy of Nassau in 1855. His best-known works are his "Qualitative Analysis" (first published in 1841) and his "Quantitative Analysis" (published in 1846); both have passed through very numerous editions, and have been translated into almost every European language. His numerous original memoirs (there are 162 titles in the Royal Society's Catalogue between the years 1842 and 1883) deal almost exclusively with analytical chemistry. One of his earliest papers (1843) deals with the composition of a mineral water from Java, and this was a subject to which he frequently returned. A series of papers on the mineral waters of Nassau (1864-68) are well known. Many of his later papers are published in the *Zeitschrift für Analytische Chemie*, which he founded in 1862, and which he continued to edit until his death.

T. E.