

Lord Rutherford.

Personal Tribute by one of his pupils.

I HAVE read with the shock of personal loss and grief of the sudden death of my great teacher, Lord Rutherford. I was keenly looking forward to meeting him in a couple of months at Calcutta at the forthcoming jubilee celebrations of the Indian Science Congress, over which he was to preside. But the cruel hand of death has dashed that hope to the ground.

It is now nearly a quarter of a century since I had the honour and the privilege of carrying on some research work under him on certain problems connected with the structure of the atom, and I can truly say that a kinder and nobler teacher it will be difficult to find. He was always ready to encourage and help the men working under him. I can still recall his open smiling face as he met me in the Physics laboratories of the Manchester University. The first question he would always put to me was: "Any luck?", and then he would discuss with me the exact point which was troubling me at the time in the particular research which I had in hand.

I was frequently invited to his table, generally at tea or supper, along with the famous Danish scientist, Dr. Niels Bohr, and Prof. Barnes of Montreal University, I think. I had also occasion several times to see him at his house alone. Not once did he show the smallest sign that he was conscious of his greatness. One could not leave him, even after only a brief talk with him, without feeling one's self a different man altogether; his very presence was a source of no small joy and inspiration.

Speaking of Dr. Bohr, I cannot but say a few words about the circumstances which led to the coming together of these two remarkable men and the great results which flowed rapidly from their close association with each other.

Dr. and Mrs. Bohr came to Manchester in 1912. Lord Rutherford had already announced the nuclear structure of the atom as consisting of a heavy positively charged central mass (α -particle) with a number of electrons revolving in their own orbits round it. But the Rutherford model lacked something and this vital deficiency a great mathematical genius like Dr. Bohr alone could supply. Taking the nuclear conception of the atom as his basis, Dr. Bohr worked out on a piece of paper the theoretical conditions which its component parts should fulfil *consistently with the then known and experimentally determined properties of the Rutherford model.*

Dr. Bohr was no experimentalist; he was a mathematician, pure and simple. He made a number of bold assumptions and it was in these bold assumptions that lay the real quality of his genius. He then worked out the properties which the atom *should possess* if the assumptions were to be accepted as correct. He showed that the Rutherford-Bohr model of the atom (as the conception of the atom outlined and envisaged by Bohr is called) not only explained with a fair approach to accuracy the known properties of the atom, but that it

did something more. It possessed what all good hypotheses must possess, namely, the power of *provision*. The Rutherford-Bohr model thus showed a way to test the validity or otherwise of Bohr's bold assumptions.

Now coming to Manchester in 1912, I think, Dr. Bohr explained to Lord Rutherford what assumptions he wanted to introduce into the nuclear conception and how upon these he had built up (with no other help than pencil and paper and guided by his great mathematical genius) the entire mechanism of the atom and its constituent parts. He suggested that his way of looking at the structure of the atom—which was only a modification or expansion of the way in which Lord Rutherford himself had looked at it—should be put to the test of experiment.

They fixed upon the line of attack. Dr. Bohr agreed to remain at Manchester on a small allowance to supervise and guide the progress of the epoch-making experiment. Two men—Mr. Evans, a lecturer in Physics at the University of Manchester, assisted by a senior research student—were deputed to look after the experiment day and night. A dark room was specially fitted up for the purpose. The necessary *eschelon* equipment was provided at considerable expense for the research.

It was a great event not only for the two scientists—one was already a Nobel Prizeman and the other was to get the same distinction some years later—but it was also an exciting event, in which all workers in the laboratories felt deeply interested.

The experiment completely justified the expectations that had been built upon the Rutherford model of the atom, plus Dr. Bohr's assumptions. After two years' hard and incessant research, carried on in a large-sized dark room in the Manchester University laboratories, certain spectral lines made their appearance just where Bohr had said they should be looked for (1915).

Like an Indian *rishi* of old, Lord Rutherford peered into the secrets of nature. He *saw* truth, but, at the same time, in the spirit of a votary of modern science, he would not be satisfied with the vision that had passed before his mind's eye till he was able to catch it, fix it and analyse it minutely with such experimental devices and contrivances as were at his command, or as he could himself construct specially for the purpose of such an examination.

I can perhaps best explain my meaning by an illustration of what I was myself privileged to see, in the course of a popular lecture at Dalton Hall, at Manchester. Lord Rutherford once tried to describe, as well as he could, the state of his mind with regard to a certain problem connected with the origin of the γ -rays which had been troubling him for a considerable time, and which he was only able to solve a good many years later.

With a trembling voice, but with child-like simplicity, truthfulness and humility, he said:

"I feel, I feel that the γ -rays proceed from a certain part of the atomic nucleus. But I do not know, really I do not know. Pray do not go away with the belief that they really proceed from that part of the atom. With all my efforts, I have not been able to trace them back to that particular spot. And yet I cannot help saying that, somehow or other, I *really do feel* that they come from that region and no other."

I have referred in general terms to the great event, the experimental vindication of the Rutherford-Bohr conception of the atom, and the incident at Dalton Hall not because I was privileged to be an eye-witness to both of them,

but because they reveal the genius of Lord Rutherford (and incidentally, also of Dr. Bohr) better than any words of mine can possibly do. After this it will be easy to see what the world of science has lost in the death of Lord Rutherford. He filled such a large space and led such an active life in the now vast domain of atomic physics that not only his own pupils, who are personally grateful to him for help and encouragement in the course of their own research work, but all earnest students of science must feel pained and grieved that the great master is no more.

RUCHI RAM SAHNI.

The Modern Study of Plants.*

THE Universities may not question the soundness of the view that "it is not merely good education but the apotheosis of worldly wisdom to seek first the cultural background and believe that the vocational proficiency will be added unto you". But they have not done all they can towards helping the public to appreciate the immense cultural potentialities of scientific thought.

In the first place, there is the general tendency for technological aspects to grow more obtrusive in Universities. Persons connected with professional courses like medicine, have been often urging that the preliminary education in Universities should have a more direct bearing on the future profession of the student. Secondly, the attitude of the University authorities should lead one to think that they are very favourably disposed towards specialisation. In the selection for University posts, they are inclined to "place undue stress on specialisation instead of placing adequate emphasis on scholarly background, versatility of intellectual interest and general culture." Another serious drawback in University education is the tendency to pay more attention to the acquisition of mere information and to pay no heed to the underlying principles.

"Specialisation" has come to stay and it is essential that workers in the field of science should have a wide background of culture. Any student proceeding to a University degree in science should have "an adequate appreciation of the principles of Physics, Chemistry, Mathematics, especially as regards statistical methods and probability theory, and lastly, but by no means least, one biological subject, preferably Botany". The evils of extreme specialisation can be remedied only through correlation of efforts and the ignorance in one department should not "become the limiting

factor in our utilisation of our extensive data in others".

"The value of Botany as an educational subject and its absolute necessity in any system of real cultural development" have not been realised by the botanists themselves. The educational value of Botany lies in the opportunities it affords for training in observation. Plant life has several points of contact with human activity and it is obvious from all points of view that man should know all about the distribution of vegetation and the plant-products of everyday use.

The several branches of Botany such as Taxonomy, Morphology, Anatomy, Cytology, Palaeobotany, Physiology, Ecology, Genetics and so on, have each a distinct contribution to make to the pure science as well as to the applied branches such as Agriculture, Horticulture and Sylviculture. The retention of Plant Physiology in Botany emphasises the importance of the study of form in relation to function.

The results of the study of Ecology have valuable practical applications. One cannot ignore ecological aspects in any scheme of land utilisation of catchment areas. The land surface covered by forests "regulates the water drainage to such a degree that despite extreme fluctuations of rainfall, the river levels exhibit no abnormal oscillation; but the effectiveness of the land surface for holding back the water varies according to whether it is under high forests, scrub, grass land". The recent disastrous floods in the Ohio and Mississippi valleys cannot be treated as "Acts of God". The study of Botany is at once good and useful. There is plenty of data to-day and it only remains for the Botanist to take his place as a man of affairs and to enlist the support of the public. Research is needed in the autecology and biology of cultivated species and it is necessary that the number of posts open to botanists should be increased. The best brains should be attracted to the study of Botany.

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* Summary of the Presidential Address of Prof. E. J. Salisbury, D.Sc., F.R.S. Botany Section, British Association for the Advancement of Science, Nottingham, 1937.