LETTERS TO THE EDITORS

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Origin of the Word 'Protein'

IN an address to the Swedish Royal Academy of Sciences on "The Place of Berzelius in the History of Chemistry" and in the Berzelius Memorial Lecture to the Royal Society, I claimed for Berzelius the authorship of the word 'protein'. This claim was based on the following passages in a letter to Mulder, the Dutch chemist, dated July 10, 1838:

"Or je présume que l'oxyde organique, qui est la base de la fibrine et de l'albumine (et auquel il faut donner un nom particulier p. ex. protéine) est composé d'un radical ternaire, combiné avec de l'oxygène dans quelqu'un de ses rapports simples que la nature inorganique nous présente."

And later in the same letter:

"Le nom protéine que je vous propose pour l'oxyde organique de la fibrine et de l'albumine, je voulais le dériver de πρωτεϊος parce qu'il paraît être la substance primitive ou principale de la nutrition animale que les plantes préparent pour les herbivores et que ceux-ci fournissent ensuite aux carnassiers."

Prof. A. C. Chibnall then pointed out to me that the credit for coining the word 'protein' was generally given to Mulder, and that the "Oxford English Dictionary" gives a reference to the first use of the word in his paper "Sur la composition des quelques substance animales" in the monthly issue of the *Bulletin des Sciences physiques et naturelles en Néerlande* dated July 30, 1838. The word 'protein' first occurs in print in this paper in the following sentence:

"La matière organique, étant un principe général de toutes les parties constituantes du corps animal, et se trouvant comme nous verrons tantôt, dans le règne végétal, pourrait se nommer Protéine de πρωτεϊος primarius."

The parallelism between these passages seemed to me too close to be an accidental coincidence; but a study of the Berzelius-Mulder correspondence edited by the late Dr. Söderbaum and published by the Swedish Royal Academy of Sciences brought to light no previous mention of the word 'protein' by either of them. Dr. Arne Holmberg, librarian of the Academy, then very kindly examined the post-marks on the Berzelius letter of July 10, 1838, which showed that it reached Greifswald on July 14, and although the post-mark at Rotterdam is illegible, the evidence of the transit time of another letter makes it probable that it reached Mulder by July 20. Mulder's paper opens with a generous acknowledgment of his debt to Berzelius, and there seems to me little doubt that he adopted Berzelius's suggestion without making any specific acknowledgment to him.

Prof. H. B. Vickery, in a paper on "The Origin of the Word Protein" in the *Yale Journal of Biology and Medicine* (22, No. 5; May 1950), examines the evidence in great detail and agrees with this view.

Thus, we owe to Berzelius in his later years not only the generalizations which he crystallized in the words 'isomerism', 'polymerism' and 'catalysis', but also the word 'protein' which he coined to express the fundamental significance of certain substances in nutrition, the sense in which we still use it to-day.

HAROLD HARTLEY

Research Council, British Electricity Authority,
Winsley Street, London, W.1.

Observations of the Golgi Substance with the Electron Microscope

OBSERVATIONS by several investigators during the past few years lend support to the view that the Golgi substance is present in living cells in the form of droplets stainable supra-vitally with certain vital dyes¹⁻⁴. The classical form of the Golgi substance has been considered to be a gross artefact induced by the development of myelin figures from droplets of phospholipid^{3,4}. This view has been accepted by some⁵⁻⁷ and questioned by others^{8,9}. It was felt that observations with the electron microscope might aid in the elucidation of this complex problem. With this possibility in mind, liver and intestinal epithelium were fixed by perfusion in two different fixatives, one the Kolatchev-Nassonov modification of Champy's fluid¹⁰ and the other a mixture of equal parts of 2 per cent osmic acid, 3 per cent potassium dichromate and 2 per cent lanthanum nitrate. The pH of the former fixative is 2.0 and that of the latter is 3.4. After fixation, slices of tissue were transferred to the same fixative for varying lengths of time. Both tissues were examined during the period of fixation with oil immersion at a thousand diameters by crushing the tissues under a coverslip in water or glycerine. Neither myelin figures nor the Golgi substance could be identified during the first twenty-four hours with the osmic acid, potassium dichromate, lanthanum nitrate mixture, nor during the first forty-eight hours fixation with modified Champy's fluid. Further treatment with 2 per cent osmic acid for three days at 37° C. resulted in the appearance of the Golgi substance with its typical form and distribution throughout both tissues after fixation in modified Champy's fluid but not after fixation in the osmic, dichromate, lanthanum mixture. Secondary treatment of the tissues preserved in the latter fixative with a mixture of equal parts of 3 per cent potassium dichromate and 1 per cent chromic acid followed by treatment with 2 per cent osmic acid for four days at 37° C. resulted in the development of faint positive images of the Golgi substance, whereas secondary treatment with modified Champy's fluid for twenty-four hours followed by treatment with 2 per cent osmic acid at 37° C. for four days resulted in the development of typical, well-blackened Golgi figures in both tissues.

Fig. 1A. Electron micrograph of a principal cell of the duodenum fixed for twenty-four hours in modified Champy's fluid, showing empty vacuoles, arrow (osmiophobic component of the Golgi substance) in the Golgi zone ($\times 2,000$ approx.). B. Tracing of the cell in Fig. 1A, to emphasize the vacuoles: mitochondria black