M. V. LOMONOSOV (1711-1765)*

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THERE are few names in the history of science that have been more strangely passed over than that of Mikhail Vasilyevich Lomonosov. Because his life was spent for the most part beyond the confines of the scientific world of the eighteenth century, his ideas and his influence never made themselves felt outside Russia, but there he is revered as the real founder of Russian science with as just a title as Liebniz in Germany, or Franklin in the United States.

No one could have excelled him in his determination to pursue and develop science. He was born the son of a poor fisherman on a remote island on the fringe of the Arctic Circle. Although Russia was then, apart from the newly formed capital of Peter the Great, sunk in complete barbarism and ignorance, he forced his way to knowledge. At the age of nineteen he went to Moscow, where, passing as a priest's son, he managed to enter a monastery school which could teach him little but Latin and church Slavonic. Three years later he was called among the most gifted pupils to the newly formed Academy at St. Petersburg, at this time an entirely foreign creation. The Government wanted to train native Russians in prospecting the great mineral resources of the country and in setting up new industries. Lomonosov was one of three who were sent abroad for this purpose. He studied mining at Freiburg, and general science under the great Christian Wolff at Marburg. There at last he came into contact with the full stream of eighteenth century scientific enlightenment, and when he went back to Russia four years later he was able far more effectively than his foreign colleagues to introduce that spirit into his country.

It would have been remarkable enough if Lomonosov had acted as an apostle of scientific culture in Russia, but he was far more than that. Brought up out of contact with the whole tradition of the West, he was, after a few years' study, able to grasp it and in a large measure to transcend it. Possibly because of his very freedom from preconceived ideas, his work shows him to have possessed a clear comprehension of physical and chemical principles a century before they won general recognition. Lomonosov's writings are few, and mostly buried in the archives of the St. Petersburg Academy, but each one of them is an expression in the most orderly and clear way of some fundamental principle in physics or chemistry.

In a century when chemical theory was deeply buried in confused mysticism, Lomonosov introduced clear and precise terms. In his "Elements of Mathematical Chemistry" in 1741, he gives definitions of elements, compounds and molecules which would pass muster to-day. Even more surprising was his description of the structure of solids, liquids and gases, and his first statement of the mechanical theory of heat and the kinetic theory of gases, leading him, in particular, to postulate the existence of an absolute zero. His analytical mind refused to deal with such concepts as phlogiston or fiery principles; to him the increase in weight of metals on calcination was due to the combination of atoms from the air which could be expelled on further heating. But lacking the devices of pneumatic chemistry, he was unable to anticipate the discoveries of Priestley.

In physics, Lomonosov's chief contribution was to meteorology (where he devised an anemometer) and atmospheric electricity. His colleague Richter was the first victim to the study of lightning that Franklin had started. Lomonosov speculated acutely on the causes of the aurora and the importance of cold fronts in weather changes. Perhaps more remarkable than any individual achievement is the way in which Lomonosov understood the nature of systematic scientific inquiry. This is shown very clearly in his lectures on "Real Physical Chemistry" in 1752. He is particularly insistent on the need for quantitative methods in chemistry, and for the measurement of all physical properties connected with chemical reactions. Of the relations between physics and chemistry he wrote: "A physicist without mathematics is blind, without chemistry he is paralysed". His understanding is shown best by his research programmes, which he initiated and carried out in the new University of Moscow, of which he was the founder and first principal. Unfortunately the note-books containing his results have been lost, but the programme of the work shows its comprehensiveness. On the solution of salts, for example, he proposes to measure:

(1) The solubility of all principal salts at different temperatures.
(2) Density of different solutions.
(3) The change in volume on solution.

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(4) Change in temperature on solution.
(5) Variation of the density with temperature, to the freezing point.
(6) Effect of solution on the boiling point.
(7) Specific heat of the solution.
(8) Mutual effect of different salts on each other's solubility.
(9) Rate of freezing.
(10) Effect of dissolved air.
(11) Whether solutions self-cooled regain heat as rapidly as those cooled externally.
(12) Effect on cohesion.
(13) Refractive indexes of solutions.
(14) Capillary constants of solutions.
(15) Microscopic examination.
(16) Effects of pressure in a Papin's digestor.
(17) Effect of an electric field.
(18) The colour of electric sparks and arcs in solutions.
(19) Comparison of solutions in vacuum and in air.

We are still trying to complete the programme he here sets out, but its recitation is enough to show what an extremely modern view he held in physical chemistry.

The distinctive character of Lomonosov's work was that he combined the mathematical inheritance of the Newtonian era, which he no doubt derived in the first place from his master and friend Euler, with an extremely lively and detailed interest in the actual phenomena of Nature and in the practices of the arts. We can recognize now a general relative decadence of science in the middle of the eighteenth century, a turn to formal mathematics and experimental dilettantism. Lomonosov stands out against this background, and foreshadowed the great work of the period of the French Revolution. He resembled Lavoisier in his mental approach to the problems of chemistry. His curiosity, though insatiable, was ordered and practical, and he was an organizer of research as much as a thinker.

Here we have a scientist of the first rank, but Lomonosov was a great deal more than that. His most important immediate influence was in quite a different sphere, that of philology and poetry. He is still revered as the first native Russian poet, and Pushkin repeatedly acknowledged his debt to him. He wrote the first Russian grammar as well as the first modern Russian history. All through his life he struggled against the cramping influence of the traditional and clerical obscurantism of old Russia and the trivial and pedantic atmosphere of the Court and the Academy. Unlike many more famous men he was never deceived by the flattery of the great, but worked steadily for the education of the Russian people.

How was it that with all his ability and achievement his work seems to have had so little immediate consequence in the world of science? Partly no doubt because of the distance of Russia and the degree to which it was cut off from the active world of English, Dutch and French science; partly because of the jealousies and vested interests of the foreign academicians; but most of all it was due to the backwardness of life in Russia, of which Lomonosov himself was so well aware when he lamented that there was no one to understand him or to carry on his work. But Lomonosov's work did not go unrewarded, however little immediate influence it had in the West. It was to him that the great liberating influence of scientific thought in nineteenth century Russia was largely due. But it is only in the past twenty years that Lomonosov's aspirations have been realized. The Soviet Union is now celebrating his 175th anniversary; but it is the utilization of the resources of the country and the spreading of scientific education to all that marks the real culmination of his work.

OBITUARIES

Mr. O. Gatty and Mr. A. S. Chessum

OLIVER GATTY, who died on June 5 at the early age of thirty-two from an accident when engaged on research in the service of his country, was an investigator of exceptional calibre and promise and possessed a mind of unusual capability. From Winchester he went to Balliol College, Oxford, where he obtained a 'first' in chemistry in 1930. In 1931 he was elected to a tutorial fellowship at his College. His interests, however, were in research rather than in teaching, and two years later he resigned in order to visit Rothamsted, where he became interested in the mechanism of living processes. He left Rothamsted to work with Prof. J. Gray in the Department of Zoology at Cambridge, and later joined my Laboratory.

Gatty showed that all the phenomena such as passivity and corrosion attending the immersion of metals in solutions of electrolytes could be interpreted on the basis of local action currents involving the presence of anodic and cathodic areas. It was with this background that he approached the subject of biopotentials. He quickly realized that thin layers of insoluble substances could not affect the electric potential difference between two phases in equilibria, but that they might produce profound effects if there existed a diffusion potential between the two phases. These diffusion potentials are in all probability the