Bergman ; the two soon became excellent friends. In 1774 Scheele published his epoch-making investigation into the black oxide of manganese, which had occupied him for two or three years, and in 1775 his memoirs on benzoic and arsenic acids. In the same year he left Upsala, in order to settle at Koping, a small place at the western extremity of Lake Miilar. Having heard that an apothe­cary’s shop was vacant, he applied for it, passed a brilliant examination before the medical college, and was appointed. But, instead of a small flourishing business, he found that he had to face confusion and debt. Undismayed he set to work, introduced order and some prosperity, and in two years bought the business from the widow of the former proprietor. During this unfortunate period Scheele must have worked very hard, for in spite of debt and diffi­culties he published in 1777 his treatise upon *Λir and Fire,* one of the most remarkable books in the whole range of chemical literature, whether its originality, its close reasoning, the number of discoveries which it contains, or the enormous amount of experimental work it represents be considered. About this time Bergman obtained for him from the Academy a grant, Scheele’s appreciation of which was shown by his reserving one-sixth for his personal wants and devoting the remainder to his experiments.

Subsequent to this period, and for the remaining nine years of his life, the only events to be recorded are the papers which he composed. Every year he published two or three, and almost every one contained a capital dis­covery, either the explanation of a phenomenon or reaction previously misunderstood or the description of some new compounds. He was at the zenith of his now European fame as a profound chemist and unfailing experimenter, and in the best years of his life, when his career was suddenly arrested. The common account is that his unremitting work, especially at night, exposing him to cold and draughts, induced a rheumatic attack, to which in the course of a couple of months he succumbed. Possibly his strength had been exhausted by long years of privation and neglect of himself. He had intended, as soon as his circumstances should enable him, to marry the widow of his predecessor. His illness, however, increased very fast, and it was on his death-bed that he carried out his design on the 19th May 1786. Two days later he died, bequeathing to his wife what property he had acquired. He was only forty-four years of age.

The discoveries with which Scheele enriched chemistry are numerous and important. Reference has been already made to the discovery of tartaric acid and of the composition of fluor-spar. The analysis of manganese oxide in 1774 led him to the discovery of chlorine and of baryta *(terra ponderosa,* as it was called), to indi­vidualizing the salts of manganese itself, including the green and purple compounds with potash, and to the explanation of how manganese colours and decolorizes glass. In 1775 he showed how to prepare benzoic acid by precipitating it from a solution in lime, and he investigated arsenic acid and its reactions with different sub­stances, discovering arseniuretted hydrogen and the green colour “ Scheele’s green,”—a process for preparing which on the large scale he published in 1778. Other researches of this period were con­cerned with the nature of quartz, clay, and alum, and with an animal concretion or calculus from which he got for the first time uric acid.

The treatise on *Air and Fire* appeared in 1777. It is unnecessary now to enter into Scheele’s argument, for, however admirably it be worked out, it started from an erroneous basis, and it is equally impossible in limited space even to enumerate the experiments and the discoveries which fill this book, and which have remained as permanent acquisitions to science through all subsequent changes of theory. Among the most important of these is his demonstra­tion that the air consists mainly of two gases,—one which supports the burning of bodies, the other which prevents it. This he snowed both analytically and synthetically. His “empyreal,” or “fire-air,” or oxygen, he obtained for his synthesis from acid of nitre, from saltpetre, from black oxide of manganese, and from several other bodies. After the discovery of this substance Scheele applied it to account for a great number of actions, and especially for its function **in** respiration and the growth of plants. He went through a long

series of actions, seemingly the most diverse in character, trying to bring them under one general law and making at every step the most acute and far-reaching observations and discovering new compounds and new reactions. Thus he incidentally made and described sulphuretted hydrogen gas, and he explained the chemical effect of light upon compounds of silver and other substances.

In 1778 he proposed a new method of making calomel and powder of algaroth. He also examined a mineral, *molybdaena nitens,* which had been supposed to contain lead, but which he showed was quite distinct, and he got from it molybdic acid. He demonstrated in 1779 that plumbago consists almost solely of carbon, and he published a record of estimations of the amount of pure air, *i.e.,* of oxygen, contained in the atmosphere, which he had carried on daily during the entire year of 1778. In 1780 he showed that the acidity of sour milk was due to a peculiar acid, now called lactic acid ; and from milk sugar, by boiling it with nitric acid, he obtained mucic acid. His next discovery, in 1781, was the com­position of tungsten, since called scheelite, which he found consisted of lime combined with a peculiar acid—tungstic acid. The follow­ing year he examined the mode of producing ether, and in 1783 discovered glycerin, the sweet principle of fats and oils. In 1782- 1783 appeared a research which—of all those Scheele conducted— exhibits his experimental genius at its very best. By a wonderful succession of experiments he showed that the colouring matter of Prussian blue could not be produced without the presence of a substance of the nature of an acid, to which was ultimately given the name of prussic acid. He showed how this body was com­posed, described its properties and compounds, and mentioned its smell and taste, utterly unaware of its deadly character. Nothing but a study of Scheele’s own memoir can give an adequate notion of the manner in which he attacked and solved a problem so difficult aud complicated as this was at the period in the history of chemistry when Scheele lived. In 1784-85-86 he returned to the subject with which he had begun his career, that of the vegetable acids, and described four new ones—citric, malic, oxalic, and gallic acids.

The preceding is a bare list of the more prominent of Scheele’s discoveries, for it must be remembered that he was not merely the first to prepare these bodies, but that he made all the compounds of them possible at the time and explained the conditions under which he produced them. Notable as is the list, and of supreme im­portance as are most of the bodies themselves, no conception can be gathered from it of Scheele’s immense power of experimental re­search,—a power that has seldom, if ever, been surpassed. His natural endowments were cultivated by unwearied practice and un­divided attention ; for scientific work was at once his occupation and his relaxation. To appreciate this fully his own account of his researches must be studied. It will thus be seen that his dis­coveries were not made at haphazard, but were the outcome of experiments carefully planned to substantiate the accuracy of theoretical views at which he had arrived. He thus saved himself unnecessary labour ; his experiments tell decisively on the question at issue, and he reached his conclusions by the shortest and simplest means. At the same time he left nothing in doubt if experiment would establish it ; he grudged no labour to make the truth indisputable ; and he evidently never considered his work complete about any body unless he could both unmake and remake it. For him chemistry was both an analytic and a synthetic science, and he shows this prominently in his researches on Prussian blue.

His accuracy, qualitative and quantitative,—considering his primitive apparatus, his want of assistance, his place of residence, the undeveloped state of chemical and physical science,—was un­rivalled. The work he executed left hardly anything to be added to it : it was as thoroughly done as it was in the power of an all- conscientious man to do. The one aim of Scheele’s life—and he never swerved from it—was the experimental discovery of the truth in nature. Like many other short-lived men of genius he compressed into his few years an amount of work of the greatest originality ; but how he managed to do it is a mystery to the less- gifted. What he might have achieved had he lived a little longer can only be surmised ; but it may be supposed that, under the newer theory of combustion to which he himself had unwittingly contributed so much, he would have made certainly no fewer and no less important discoveries thau those which were the outcome of its erroneous predecessor.

Scheele’s papers appeared first in the *Transactions* of the Swedish Academy of Sciences, in Crell’s *Neue Entdeckungen* and *Annalen,* and in other periodicals. A list of them is given in Fuchs’s *Repertorium der chemischen Litteratur,* Jena, 1806-1808 ; in Reuss's *Repertorium Commentationum,* vol. iii., Göttingen, 1803; andin Poggendorffs *Biographisch-literarisches Handwörterbuch,* Leipsic, 1863. They were collected and published in French, English, Latin, and German : *Mémoires de Chymie,* 2 vols.. Paris, 1785-88 ; *Chemical Essays,* by Thomas Beddoes, 1 vol., London, 1786; *Opuscula,* translated by Schäfer, edited by Hebenstreit, 2 vols., Leipsic, 1788-89; *Sämmtliche Werke,* edited by Hermbstädt, 2 vols., Berlin, 1793. The *Treatise on Air and Eire* appeared in German, Upsala and Leipsic, 1777, and again in 1782 ; in English, by J. R. Forster, London, 1780; in French, by Dietrich, Paris, 1781. (J. F.)

SCHEFFER, Ary (1795-1858), Dutch painter, who was born at Dort on 10th February 1795, represents the senti-