steel. It is produced only when the latter cools down and has partly solidified. Steel that will produce blowholes contains in the molten condition dissolved carbon and oxygen, and for each temperature and composition there is a particular equilibrium at which no chemical reaction takes place. The heat is then what is called "dead-melted." If, on one hand, the temperature is raised, the reducing action of the carbon is intensified, and carbon monoxide will be evolved; if, on the other, the temperature is lowered, nothing happens until the steel has partially solidified. This causes an increased concentration of carbon and oxygen in the still liquid portion, as a result of which carbon monoxide is evolved. This gas is unable to escape, and by its pressure produces the blowholes. On cooling, it is gradually absorbed by the now solid metal.

As yet almost nothing is known as to the condition in which these gases exist in metals and alloys. Prof. McBain pointed out in his contribution to the discussion that the occlusion of gases by metals comprises processes which are special instances of the general group of different phenomena known collectively as "sorption," and that in the vast majority of cases the intermingling phenomena have not been disentangled or even experimentally identified. It is necessary to take into consideration true adsorption (surface condensation), true absorption (true solution in a solid), and chemical reactions that may ensue.

Sir Robert Hadfield finally considers briefly the methods which have been found effective in producing sound steel. As he points out, great difficulties were experienced in the early days of making steel castings in producing sound metal. The very useful element silicon was scarcely obtainable except in combinations which caused as much trouble as the unsoundness itself. High-percentage ferro-silicons with low carbon and silico-speigels were unknown. Manganese, though useful, was only a partial cure, and aluminium as a commercial metal had not yet arrived.

It appears that it was three French metallurgists who introduced and perfected the successful production of ferro-alloys containing high percentages of silicon and also manganese, as a result of which the manufacture of sound steel by commercial processes on a large scale was rendered possible. These men were MM. Euverte, Pourcel, and Gautier, of the Terre Noire Works. Credit should also be given to Hall in America and Héroult in France, who were the pioneers of the production of aluminium on a commercial scale. This element is now one of the most valuable available for the prevention of blowholes in steel. As an instance of the successful production of sound steel castings at the present day Sir Robert Hadfield gives some details of the casting of hydraulic cylinders for cotton baling presses. These cylinders have no mechanical work done upon them, but are used in the cast state. They may run up to a length of 30 ft. The ram measures from 7 in. to 9 in. in diameter. The walls of the cylinders seldom exceed $2\frac{1}{4}$ in. in thickness, and have to stand the hydraulic test pressure of 4 tons per sq. in. The steel is cast at a temperature of about 1540° C., and is poured into sand moulds which are liable to give off gases. Its contraction is slightly more than 0·25 in. per ft., so that the mould is not less than 7 in. longer than the cylinder itself when cooled down. Below 1500° C. the steel quickly loses its fluidity, and not many degrees lower it is quite pasty. The fact that, in spite of the difficulty of meeting these conditions, satisfactory cylinders can be made indicates that the art of steel casting has reached a high stage of technical perfection.

H. C. H. C.

PROF. J. J. T. SCHLŒSING.

AGRICULTURAL investigators in all countries will learn with regret of the death of Prof. Jean Jacques Théophile Schlœsing at Paris on February 8. Although Prof. Schlœsing had attained the advanced age of ninety-four, his vigour and mental alertness were unusually good, and he had had the satisfaction of seeing his son continuing in his own branch of science, doing work of great importance, and making a reputation scarcely less distinguished than his own.

Schlœsing was born at Marseilles on July 9, 1824; he entered the Polytechnic in 1841, and was appointed director of the Ecole des Tabacs in 1846. There he began an important series of analytical investigations the purpose of which was to improve the method of detecting and estimating the common constituents of soils and plants, such as potassium, ammonium, nitric, phosphoric, and hydrochloric acids, and the common organic acids, such as acetic, tartaric, citric, oxalic, malic, and others. The current methods of dealing with natural products were sometimes exceedingly laborious, and lacked even the merit of accuracy; the determinations of ammonia in rain-water made with all possible care by Lawes and Gilbert in 1853 had involved the distillation of 2 cwt. of rain and evaporation of the distillate with sulphuric acid; even then the results came out something like 100 per cent. too high. It is impossible, therefore, to over-estimate the value of careful analytical investigations such as those made by Schlœsing.

His next important series of investigations was on the soil. By a lengthy washing process he obtained a preparation of the finest clay particles which remained indefinitely suspended in pure water, but could be precipitated by traces of a calcium or magnesium salt. This was commonly regarded as being in some sense the essential clay, and agricultural chemists marvelled at the minute amount present even in heavy soils. The conception served a useful purpose, but it has now been replaced by a broader one: the soil is now considered to be made up of particles varying from 1 mm. downwards to molecular dimensions, the different groups merging one into another without perceptible breaks. The clay group is assigned for convenience an upper limit of 0·002 mm., but this is regarded as purely conventional.

Another important investigation had to do with the movements of lime in the soil. The conditions of solubility were determined, and deductions were drawn which threw important light on the practices of liming and marling, and on the presence of lime in natural waters.

Further, Schlœsing studied the effect on plant growth of the carbon dioxide and ammonia present in the atmosphere, in the soil, and in natural waters. He set up the well-known hypothesis that the proportion of carbon dioxide in the atmosphere is related to the extent of dissociation of the bicarbonates in the sea. The sea was thus regarded as a reservoir which equalises the stock of carbon dioxide in the atmosphere, taking up any excess that might be formed at any time, and supplying any deficit from the average amount should such ever arise.

Schlœsing's best-known work, however, was on nitrification. For a long time it had been known that nitrates are gradually formed when plant or animal residues, farmyard manure, etc., are incorporated in the soil. The process was of much technical importance in the seventeenth and eighteenth centuries as the source of nitrate for gunpowder. During the Thirty Years' War and other great Continental wars the various Governments had been seriously concerned in these so-called nitre beds, and had done a good deal to stimulate their development. The conditions of the change were tolerably well ascertained, but nothing was known as to its mechanism.

It has several times happened in the history of civilisation that agriculture has benefited by knowledge gained during war. The mass of information accumulated during the eighteenth-century wars, and apparently rendered useless in the nineteenth century by the promise of peace and the discovery of nitrates in Chile, was found to be of fundamental importance in agriculture. It was found that the nutrition of plants so far as nitrogen was concerned depended on the nitre-bed processes; organic nitrogen compounds, useless as plant nutrients, when added to the soil became converted into highly valuable nitrates; the more rapidly this change could be brought about, the better for the plant. So long as the mechanism of the change was unknown, the old knowledge was simply empirical and incapable of full utilisation. Many investigations were therefore made, but for years the problem remained unsolved. The balance of opinion was in favour of a purely physical process, but there was also a strongly supported chemical hypothesis.

Schlœsing and Muntz had been working at the formation of nitrates in sewage during the process of nitrification, and they noticed an inert period of twenty days before the commencement of nitrification. With characteristic shrewdness they observed that this delay could scarcely arise if the process were purely physical or chemical; some biological factor seemed to be indicated. In order to test this possibility they added a little chloroform to the sewage; nitrification at once stopped. They then removed the chloroform, and "seeded" with a little fresh sewage; after an interval nitrification began again. This afforded strong evidence that the process was due to living organisms, and in course of time the proof was made more rigid by Winogradsky's isolation of the specific organism.

This research is one of the foundations of modern soil bacteriology, and for this alone Schlœsing would be remembered. But his other work has also played an important part in the development of the subject, and he may justly be regarded as a worthy successor to the great Boussingault, whom he followed at the Conservatoire des Arts et Métiers in 1887. He carried on the high standard set by his predecessor, and leaves a name that will long be held in high honour and esteem.

E. J. Russell.

NOTES.

The Prime Minister's list of New Year honours, the publication of which has been delayed by circumstances arising out of the armistice, was issued on Monday, and includes the following names of workers in scientific fields:—*Baronet:* Dr. Norman Moore, president of the Royal College of Physicians. *Knights:* Mr. R. T. Blomfield, past president of the Royal Institute of British Architects; Lt.-Col. J. M. Cotterill, C.M.G., consulting and late acting surgeon, Edinburgh Royal Infirmary, and lecturer in clinical surgery, Edinburgh School of Medicine; Prof. Israel Gollancz, secretary of the British Academy since its foundation; Prof. R. A. Gregory, chairman of the Organising Committee, British Scientific Products Exhibition; Mr. H. J. Hall, organiser under the Ministry of Munitions of the section dealing with the production of fertilisers; Dr. Edward Malins; Mr. J. H. Oakley, president of the Surveyors' Institution; Prof. W. Ridgeway, professor of archæology, University of Cambridge; Dr. C. S. Tomes, F.R.S.; and Dr. T. J. Verrall, chairman of the Central Medical War Committee.

The joint meeting of the Faraday Society and the Röntgen Society, held at the Royal Society on Tuesday for the discussion of "The Examination of Materials by X-rays," afforded remarkable testimony to the wide interest taken in the opportunity which such a meeting provides of bringing together theoretical knowledge and practical experience of a scientific subject. The meeting-room of the Royal Society was crowded, and one twice the size could easily have been filled. The discussion, of which we shall give an account in a later issue, began in the afternoon, and was continued in the evening after adjournment for dinner, to which a large company was invited by the president of the Faraday Society, Sir Robert Hadfield. It was an unusual privilege for the Royal Society to grant the use of its meeting-room for a discussion organised by other societies, but there could not be a more appropriate place for such a meeting, and the society itself might with advantage arrange for similar meetings at which all scientific workers in wide fields are actively interested. The success of the Faraday Society discussions is due chiefly to the rare combination of pure and applied science and unbounded energy manifest in Sir Robert Hadfield, and to the untiring work of the secretary of the society, Mr. F. S. Spiers. It was particularly pleasing to note the number of the younger generation of scientific workers present at the meeting. No more encouraging sign could be