may be quoted an ingot of steel intended for the production of weldless tubes by the Pilger process. This ingot, weighing just above 3 tons, was made by the basic Siemens process and was of the following average composition: Carbon, 0·064; manganese, 0·35; silicon, 0·012; sulphur, 0·039; phosphorus, 0·010 per cent. The sulphur print and the macro-etched structure are shown in Fig. 2 (*a*) and (*b*). It will be seen that four zones may be distinguished. There is, first, a thin solid outer skin about ½ an inch thick. Within this there is a zone about 4 inches thick free from segregation but containing numerous elongated blow-holes, especially in the bottom half of the ingot. Zone 3 consists of a thin envelope of highly segregated material containing numerous blow-holes of globular form. Finally, there is the central portion of the ingot, which appears to be more impure than zone 2, and the upper portion of which contains blow-holes both with and without segregates. There is no major pipe cavity, but there are shrinkage cavities in the centre of the ingot and traces of the V type of segregation. In the lower half of the central zone a particularly unsound area containing segregated regions of rather peculiar form is to be seen. An explanation of this unsoundness of the bottom of this ingot has not yet been found, but it is possible that the condition of the bottom plates on which the ingot mould had rested played some part in it.

Except in the case of silicon, the magnitude of the segregation phenomenon for the various elements in these steels containing blow-holes is of the same order as is found in the 'killed' piping steels. In the tube ingot a high value for the silicon content, however, was detected near the bottom of the ingot, but whether this would occur normally is still uncertain, since, as has already been mentioned, the condition of the bottom plates may have had some influence. Concerning the general distribution of the elements there is in these ingots, as in those made from piping steels, a concentration of the impurities (excepting silicon) in the upper parts of the ingot, though there is little indication of the negative segregation of carbon, sulphur, and phosphorus in the lower central region.

All the ingots show evidence of an increased silicon content in the lower middle portion to an even more marked degree than do the ingots of the 'piping' type dealt with in the first report. The ingots, further, contain V segregates near the central axis, though these are not so distinct as they are in the piping steels. The tube steel did not show the Λ segregate, though in the case of 'semi-killed' ingots this is again found, confined, however, in general, to a very narrow zone, except in the case of two ingots which had been cast at a low temperature. A distinctly interesting observation was made in connexion with an ingot weighing 3 tons 6 cwt. of a 'free-cutting' steel produced by the basic open-hearth process. The composition of this material was carbon 0·12, manganese 0·66, silicon 0·03, sulphur 0·113, and phosphorus 0·098 per cent respectively. Although the silicon content is very low and no additions of aluminium were made, the ingot showed the typical structure and features of ingots of 'killed' steel. The liberation of gases which is typical of low silicon, 'unkilled' steel has in this case been prevented by the high content of sulphur, an element which evidently acts as a powerful deoxidising agent.

The present report concludes with interim statements of work which is being done in the University of Sheffield on changes of the density of steel in the neighbourhood of the melting point and the viscosity of molten steel, and also researches being carried out at the Royal Technical College, Glasgow, on the freezing and melting ranges of the steels dealt with in the two reports and on the sulphides present in these steels. The amount of work which has been carried out for the purpose of these reports by the steel-making firms and metallurgical institutions of Great Britain is extremely great, and the value of the work when it is complete, both to the manufacturer of steel and to the user, cannot be over-estimated. As an example of a scientific investigation of a point of practical metallurgical importance, it would be difficult to call to mind any previous piece of work of this magnitude carried out with anything like the care and industry which has been shown in the present case. F. C. T.

Obituary.

PROF. E. M. CROOKSHANK.

THE sudden death of Prof. Crookshank on July 1 removes one who was a pioneer of bacteriology in Great Britain. He came of a family of soldiers, but at an early age showed a liking for scientific work, and after school days was first a pupil of Sir Ray Lankester at University College, whose teaching doubtless influenced his choice of career. Obtaining a science exhibition at King's College, London, he entered there as a medical student, and finally graduated as M.B. with honours in the University of London. During his training at King's College, Lister arrived in London to become surgeon to King's College Hospital, and Crookshank was one of his dressers and afterwards house surgeon at the Hospital. He thus early became imbued with the teaching of Lister and acquainted with the germ theory of disease. In consequence of his experience under Lister he was selected for special duty in the Egyptian Expedition of 1882, was present at the battle of Tel-el-Kebir, and received the medal and Khedive's star for his services. He wrote a report on the antiseptic methods employed in the campaign and gave valuable evidence before the Royal Commission on Medical Services in Egypt.

Following this, Crookshank decided to take up bacteriology as a career, and proceeded to study in Paris under Pasteur, and afterwards in Berlin under Robert Koch. Returning to London, he published in 1886 his "Manual of Bacteriology," which passed through four editions, was translated into French, and was the standard text-book of bacteriology at

the time in England. It was illustrated with many beautiful coloured plates, drawn, some by himself and others by Mrs. Crookshank. He was elected at about this time to a professorship of bacteriology in King's College, London, and founded there the first laboratory of bacteriology to be established in Great Britain.

Crookshank now devoted himself to research and educational work. He studied photomicrography, and in 1887 published a volume entitled "Photography of Bacteria." Many of his photomicrographs of this early period are excellent, and scarcely to be bettered now. In 1885 and 1886 he was studying the malaria parasite and trypanosomes. He was one of the first to recognise and confirm Laveran's work on the malaria parasite, and also confirmed the work of Evans on the trypanosome of surra, a disease of horses; and he published a paper in the *Journal of the Royal Microscopical Society* (1886) on the trypanosome of the rat, and his study of this parasite left little for later investigators to describe as regards its morphology and structure. Crookshank now in quick succession undertook researches on behalf of the Government, and furnished reports to the Agricultural Department of the Privy Council on scarlet fever and the Hendon cow disease (1887); anthrax, particularly in swine (1888); tuberculosis and actinomycosis in cattle (1888). His investigation of the Hendon outbreak of disease in cows, also of a similar outbreak in Wiltshire, proved that the condition was one of cow-pox.

This doubtless directed Crookshank's attention to smallpox and vaccination, with the result that he published in 1889 a considerable work in two large volumes on the "History and Pathology of Vaccination." He surveyed the earlier literature, and for this purpose the old book shops of Leipzig and elsewhere were searched for early and rare tracts and treatises, of which he acquired a unique collection. His views on the subject were decidedly heterodox, and at the time gained few adherents, though his criticism of some of the then popular conceptions would now be admitted as sound. He also studied the bacterial flora of calf-lymph, and while isolating numerous species from it, definitely asserted that not one of them is peculiar to vaccine lymph, and that the nature of the contagion is unknown.

With the exception of two papers on the chemistry of Koch's old tuberculin, this was Crookshank's last work of scientific importance, and in 1901 he resigned his professorship, being elected emeritus professor, and retired to his estate near East Grinstead. Here, while taking his share in local interests and becoming a Justice of the Peace, he maintained to the last a keen interest in scientific work and took a deep and active interest in the Royal Veterinary College, where he had lectured in early years, and of which he was a governor for nearly forty years, and had much to do with the recent developments in that institution.

Crookshank travelled much, was a keen fisherman, a good shot, and a skilled hunter of big game. Within the last year he had the good fortune to find and excavate some interesting Roman remains on his estate. R. T. HEWLETT.

As a result of a motor-cycle accident near Aberdeen on July 2, Mr. Alexander Reid has died at the early age of twenty-two years. A young man of great personal charm and scientific promise, he took his degree with honours in mathematics and natural philosophy two years ago at the University of Aberdeen. Since then he has been engaged in teaching and research. His work on the diffraction of cathode rays through thin films of celluloid, a preliminary account of which appeared in NATURE a year ago, has attracted wide interest. By a melancholy coincidence his definitive paper appeared in the *Proceedings of the Royal Society* within a day or two of his death. His remarkable success in the short time allowed him makes his early death peculiarly tragic, and his lovable nature had endeared him to all who knew him.

WE regret to announce the following deaths:—

Sir Frank Sly, K.C.S.I., formerly Governor of the Central Provinces, who took a prominent part in the development of agricultural research in India, on July 16, aged sixty-two years.

Sir George Wills, Bart., president of the Imperial Tobacco Company, a munificent benefactor of the University of Bristol and of the Bristol Museum and Art Gallery, on July 11, aged seventy-four years.

News and Views.

MANY scientific workers will remember the disappointment caused at the Oxford meeting of the British Association by the exclusion of a film of Chilian and Peruvian birds with which Mr. R. C. Murphy, of the American Museum of Natural History, had intended to illustrate a lecture. This year two similar incidents have occurred. Mr. Beebe, the eminent naturalist, was obliged to pay full duty on a film of a microscopical subject which he introduced for the purpose of exhibition to a learned society, and Mr. Wright, the distinguished American astronomer, who wished to use a film to illustrate a lecture before the Royal Astronomical Society, not only had to pay duty on his film, but was also put to a good deal of trouble by the Customs authorities. On hearing of Mr. Beebe's experience, the Association of Scientific Workers communicated with the Financial Secretary of the Treasury asking, either that special concessions should be granted as a matter of courtesy to accredited scientific workers wishing to introduce such films from abroad, or that the Finance Act be so amended as to allow for their importation without payment of duty. Independently, Captain Ian Fraser moved an amendment to the Finance Act of 1925 in the House of Commons on July 3 to the same effect. No decision has yet been reached, but, replying in the House of Commons to a question put by Sir Harry Brittain, the Financial Secretary to the Treasury