in the visible (the F-band), the rock salt thereby acquiring a yellow and silvine (potassium chloride) a blue colour. The F-band is generally recognized to be due to electrons attached to metal ions, and can be produced in other ways; for example, by heating in alkali vapour, so that positive ions and electrons diffuse into the crystal. The coloured crystal is, however, an insulator at low temperatures, and shows photoconductivity only when illuminated with wave-lengths in the F-band. It is therefore often stated that these electrons are located at internal surfaces or cracks, which might be expected to play some role in rendering the electron immobile[19]. The work of Landau shows, however, that this hypothesis is unnecessary; this will now be explained.

The large dielectric constant of polar crystals is partly due to an actual displacement of the positive and negative ions from their mean positions by an external field. The time taken to polarize the medium is of the order 10^{-12} sec., and since the electron jumps from atom to atom in a time comparable with 10^{-15} sec., it will not in general have time to polarize the medium as it goes. If, however, the electron remains in the neighbourhood of one metal ion for a sufficiently long time, it will polarize the surrounding medium, the positive ions moving into new positions of equilibrium nearer to, and negative ions farther from, the electron. The electrostatic field round the electron falls from $-e/r^2$ to $-e/\varkappa r^2$, where $\varkappa$ is the dielectric constant. Therefore, in the field of the polarized medium, the potential energy of the electron is

$$V(r) = -\left(1-\frac{1}{\varkappa}\right)\frac{e^2}{r}$$

In the 'potential hole' thus created, the electron will have a series of bound stationary states, similar to those for an electron in the field of a hydrogen atom, for which $V(r)$ is $-e^2/r$. The absorption band (F-band) corresponds to the removal of the electron from this potential hole and is thus analogous to the ionization of a hydrogen atom; the electron is then free to move through the crystal, and the potential hole disappears.

These trapped electrons have, according to Frenkel[16], a certain very small mobility, since the electron can jump from ion to ion and the surrounding ions move into displaced positions at the same time. Since by a well-known theorem of electrostatics a charged particle in a dielectric medium is repelled by any boundary of or hole in the medium, the most stable positions for trapped electrons will be as far as possible from any internal crack!

The theory of trapped electrons outlined here is quite general and can be applied to any polar solid; in future developments of the theories of the conduction of electricity in semi-conductors and insulators, it may prove of considerable importance.

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Obituary Notices

Prof. A. R. Ling

ARTHUR ROBERT LING, whose death took place on May 14, owed his career as a research chemist to the inspiration of Prof. H. E. Armstrong, under whom he studied at the Finsbury Technical College in 1883 and thereabouts. He was encouraged to work on halogen derivatives of the nitrophenols, and he afterwards extended his investigations to similar derivatives of quinones, and in this began his long association with Julian Baker. The latter was continued when, as chemist to the London Beetroot Sugar Association, he carried out his routine work in the daytime, and in the evenings and at week-ends prosecuted with Baker his extensive investigations on the constitution of starch.

It is in the fields of starch and sugar chemistry and as an authority on brewing that Prof. Ling was best known. Ling's work during the decades preceding and succeeding the beginning of the century is recognized as being of sound character, and the interpretation of many of his results in the light of present-day knowledge and concepts adds materially to the known chemistry of starch and the mechanism of its degradation by diastase. It had among other things, the important effect of preventing a hasty acceptance of erroneous views which were widely held at the beginning of the century.

After leaving the Beetroot Sugar Association, Ling practised as a consulting chemist, his special fields being the brewing and sugar industries. From 1895,

that is, the time of its commencement, until 1920, he was editor of the *Journal of the Institute of Brewing*, and for many years technical editor of the *Brewers' Journal*, work for which he was most admirably suited and which he performed in a most competent manner. During the War period his work on the subject most dear to him, starch, was apparently almost at a standstill.

In 1920 Ling was appointed professor of brewing at the University of Birmingham, where he brought about the institution of an honours degree in biochemistry of fermentation. Now with better facilities than had hitherto been at his disposal, he was able to resume his work on starch. It was one of the great griefs of his declining years that this later work was incomplete. Nevertheless, more recent knowledge of the enzymes which were present in some of the preparations used by him at that time, now known to be composite, reveals that many of the results he obtained in conjunction with Nanji can be explained, although not in the way put forward at the time. In 1931 Ling retired from the chair at Birmingham, and generously bequeathed to the University the whole of his library of scientific books and journals.

To those who were privileged to know him well Ling was a kind-hearted man, to whose encouragement many younger men owe a great deal. His enthusiasm for research was inspiring and his knowledge of the literature in his field amazing. In his domestic life he was dogged by ill fortune, serious illness and death being frequent visitors, culminating in the loss of his wife in 1935. Notwithstanding the latter and his own persistent ill health in the last two years, he maintained an active interest in scientific and technical work right up to the week of his death. R. H. HOPKINS.

WE regret to announce the following deaths :

Prof. Alfred Adler, founder of the Society for Individual Psychology, originally called the Society for Free Analysis, at Vienna, on May 28, aged sixty-seven years.

Prof. Ladislas Natanson, formerly professor of physics in the Jagellonian University of Cracow, on February 26, aged seventy-three years.

Prof. A. G. Perkin, F.R.S., emeritus professor of colour chemistry and dyeing in the University of Leeds, on May 30, aged seventy-five years.

News and Views

Soviet Expedition to the North Pole

THE comprehensive Soviet scheme for the exploration and utilization of arctic territories has been carried another step forward by the institution of a polar research station within twelve miles of the North Pole. An aeroplane carrying Prof. O. Schmidt and several others left the meteorological station on Rudolf Island, Franz Josef Land, in lat. 81° 47′ N. on May 21 and flew over the Pole before landing on a convenient floe. A few days later three other aeroplanes arrived with materials for the hut, instruments, stores and fuel. The way between the station and Rudolf Island has been marked every thirty miles by bombs of dye stuff. The hut, which is of metal, wood and rubber, is to be maintained for a year. It will be in wireless communication with Moscow, which will receive daily weather bulletins. The chief object of the enterprise is meteorological research, since only casual data have hitherto been obtained north of lat. 80° N. Such data will have a practical bearing on the proposed air route between the Soviet Union and the United States. The station is, of course, afloat and is reported to be drifting at the rate of about half a mile an hour. The direction is not stated : it may be rotary or more likely towards north-east Greenland. However, so long as the station remains in a high latitude, its purpose will be fulfilled, for its location actually at the Pole has more dramatic than practical value. A moving station will certainly facilitate hydrographical work. There is little likelihood of the floes disintegrating unless they drift into a much lower latitude or approach the area of ice pressure off northern Greenland.

The Thames Barrage Proposal

A DEBATE in the House of Lords on May 26 revived the publicity given about two years ago to a somewhat grandiose scheme for impounding the tidal area of the Thames above Woolwich by means of a dam, or barrage, across the river at that point. The scheme received a notable degree of attention at the time as it presented a number of attractive features, and was put forward with considerable plausibility of argument by its promoters, who have since been busily engaged in propaganda work through the agency of an organization, called the Thames Barrage Association. That a number of the promoters' contentions are true, or rather that they have a basis of fact, cannot be gainsaid by a fair-minded critic. There are undoubted defects to which, in some degree, the scheme might afford a remedy, principally, perhaps, in regard to mitigating the pollution, by tidal reflux of sewage effluent, of the river above the suggested dam. The promoters claim that the evil would be entirely eliminated ; but this could scarcely be the case in view of the direct discharge, into the area proposed to be impounded, of sewage-laden tributaries. In all probability, there would be intensification of pollution immediately below the dam for lack of current movement.

THERE are, however, other serious counter arguments which cannot be disregarded or minimized. London, in addition to being a metropolis, is a great port, one of the largest in the world, and the requirements of shipping must therefore claim an important degree of consideration. As was pointed out by Lord