

on account of the great instability of the costs of labour and materials. But surely a time has now been reached at which some stability in these matters has been attained, and costs of operations may be discussed once more with pre-War freedom, to the advantage of the coal industry as a whole.

The final chapter of the book deals with pneumatic separation, added as an afterthought as it were, and lending assurance to the view formed, that the subject matter had been drawn together in a hurry to the detriment of the treatment.

To summarise: considering how much matter has been written on mineral dressing, it is obvious that a student of coal dressing would do well to revert to the field of metalliferous mineral dressing, and work forward steadily to the narrower field of coal dressing, when the book might be very useful. The outstanding useful features are the descriptions of machines and processes, and all other considerations are subordinate to this.

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The Zeeman Effect.

Magnetische Zerlegung der Spektrallinien. Von Prof. Dr. P. Zeeman und Dr. T. L. de Bruin. (Sonderdruck aus Handbuch der physikalischen Optik, herausgegeben von Prof. Dr. E. Gehrcke, Band 2, Hälfte 2, Teil 1.) Pp. 595-682 + 1 Tafel. (Leipzig: Johann Ambrosius Barth, 1927.) n.p.

THERE is perhaps no name that has been more frequently mentioned in physical writings in the last ten years than that of Prof. Zeeman, and we welcome the authoritative account of the magnetic splitting of spectral lines which he has written with the collaboration of Dr. de Bruin.

The Zeeman effect has so dominated the theory of spectra in recent years that its theoretical aspect is fully discussed in all modern books on atomic structure, with but meagre accounts of the experiments on which the theory is based. It is therefore very interesting to have the experimental processes described in some detail, for it is easy to forget how difficult they are. Thus theory takes for granted that a certain component is displaced to a distance of say $17/15$ of that of the normal effect, and forgets that the line itself has a finite breadth, that the magnetic field is not always precisely known, and that the distinction between $17/15$ and $16/14$ will anyhow only amount to a very small fraction of an Ångström unit. So, too, theory has built a vast edifice on measures of intensity, and it is easy to forget that the analysing grating itself alters the relative intensities of

differently polarised components, so that only the most thorough investigation of these disturbances brings out the right result.

The work under notice begins with a historical account of the discovery, recording the fact that Prof. Zeeman was partly incited to look for it by reading that Faraday had attempted to do so, though without success. No mention is made of the fact, perhaps quite legendary, that when the circular polarisation was first observed, the electron was determined to have a positive sign through a blunder, with which everyone will have the sincerest sympathy who has ever had to decide the sign of any gyroscopic effect. The history is followed by a description of the apparatus necessary to observe the effect, and recounts the improvements introduced by various experimenters in magnetic field, grating, source of light, etc.

The authors then proceed to develop the theory according to the dynamical principles on which it was worked out. But nothing could better illustrate the great rate at which the theory has advanced than the fact that though their account contains everything known up to about the end of 1926, a great deal of it is now unnecessary. The wave theory has tidied up all the quasi-dynamical analogies by which the formulæ were originally suggested. For example, the interrelationship of the Zeeman patterns in weak and strong fields was worked out by a semi-empirical rule "the permanence of g -sums," but it is now possible to trace the connexion in detail, and the permanence of g -sums appears merely as an elementary property of the coefficients of an algebraic equation. In fact, between 1926 and 1928 the building has arrived at the stage when most of the scaffolding can be taken down.

Though this main part of the theory has attracted most attention in recent years, and is therefore most fully discussed, other aspects of the Zeeman effect are also reviewed. Thus there is a short account of the effect in the more complicated spectra of the 'second grade' and in bands, in which both theory and experiment are still very defective, and an account of the inverse effect in solids and liquids. There is also an account of the resonance phenomena of Wood and Ellett. Furthermore, the Zeeman effect has achieved the dignity of having an 'applied' branch as well as a 'pure,' and a section is devoted to the remarkable discoveries of Hale concerning the alternating rotation of sunspots. Altogether, there is no other place where so full and trustworthy an account can be found of the various aspects of the Zeeman effect.