Acta Cryst. (1955). **8**, 738

A new type of X-ray diffraction picture (high-voltage Laue photographs).

By H. S. Peiser and J. R. Rait, *Research Laboratory, Hadfields Limited, Sheffield 9, England*

(*Received 24 June 1955 and in revised form 6 August 1955*)

Normally, X-ray crystallographic photographs are taken at low effective tube voltages (certainly less than 60 kV.). For the radiography of metal specimens higher voltages are commonly used. Diffraction effects are then not discerned except on photographs showing 'diffraction mottling' described in detail and recognized as a diffraction effect by Glaisher, Betteridge & Eborall (1944).

In order to investigate this phenomenon systematically a method analogous to conventional X-ray crystallographic techniques has now been used. A collimated pencil of 'white' X-rays (up to, say, 190 kV.p.) has been allowed to fall on the specimen (approximately $\frac{1}{4}$ in. thick effectively absorbing all radiation of less than about 90 kV. equivalence). The X-ray transmission photograph recording up to about 12° deviation from the primary beam (Fig. 1) is characterized by polychromatic streaks, which are explained by considerations in reciprocal space ($d^* = 1/d$) where the reflecting spheres are of very large radius compared with the close proximity to the origin of the reciprocal-lattice points responsible for reflexion (Fig. 2). Owing to the finite size of reciprocal-lattice points and the small dispersion of the reflecting spheres near the origin, Bragg's law may be effectively obeyed for a wide range of wavelengths.

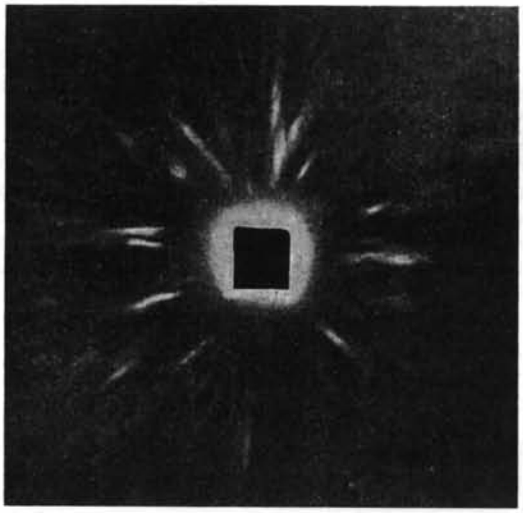

Fig. 1. Typical high-voltage Laue transmission photograph (190 kV.p.; coarsely-grained steel specimen).

The new photographs are described as 'high-voltage Laue photographs' because the method of exposure is entirely analogous to conventional Laue pictures (stationary specimen and 'white' X-radiation). Nevertheless, it must be appreciated that, whereas in conventional Laue pictures the X-ray reflexions are monochromatic spots, the streaks in high-voltage Laue photographs are polychromatic.

Apart from thus explaining more fully the phenomenon of diffraction mottling (caused by an appreciable proportion of the energy of a 'white' primary beam being deflected by a single crystal), the new technique offers applications to grain-size and internal-stress measurements in specimens at depths previously inaccessible to X-ray diffraction studies. A preliminary exploration of the suitability of this method to the study of fatigue in metal specimens is being undertaken.

We are indebted to Mr P. Crawshaw for taking many X-ray pictures of this type and to Mr E. W. Colbeck, Metallurgical Director of Messrs Hadfields Limited, for permission to publish this communication.

Reference

Glaisher, W. H., Betteridge, W. & Eborall, R. (1944). *J. Inst. Met.* **70**, 81.

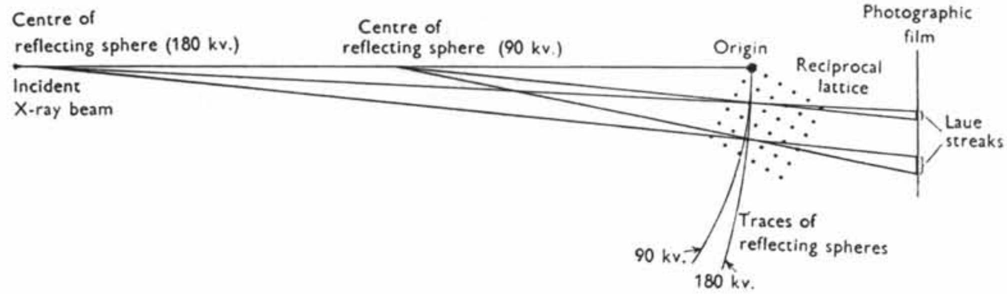

Fig. 2. Reciprocal-lattice treatment of reflecting conditions.