Physics. — *The testing of monocrystalline wires.* By W. J. DE HAAS and P. M. VAN ALPHEN. (Communication N⁰. 204*d* from the Physical Laboratory Leiden).

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Introduction. Since several years the change in resistance of monocrystalline wires at low temperatures has been investigated in the cryogenic laboratory.

A difficult problem in this investigation is the testing of the monocrystalline wires.

For thick wires the method of BRIDGEMAN [1]) can be used with success : The wire is examined in a beam of parallel light. The surface of the etched wire is covered with a great number of very fine holes the walls of which consist of crystal planes (negative crystals).

For a definite position of the wire with respect to the incident light this is reflected by these planes, so that the whole wire flashes up, at least when it is monocrystalline. At the point, where eventually a collateral crystal occurs, the wire remains dark, the crystal planes having there another direction, so that they do not reflect the light in the direction of the eye of the observer.

For thinner monocrystalline wires (0.2 mm. and less) the method of BRIDGEMAN cannot be used. We will describe here a method, which we invented and worked out not to fix the direction of the crystal axis but only to test the monocrystallinity of the wire.

The method is a very quick one and in the course of time it has been proved to be very useful.

It consists in the making of a series of LAUE photographs of the wire. The wire is transversed by a fine beam of white X-rays, so that a number of LAUE spots is formed on a film behind the wire.

In order to see whether we have to do with one single crystal, the wire and photographic plate are displaced together in the direction of the wire and another photograph is taken. If at the place now transversed by the RÖNTGEN rays the crystal lattice has the same orientation as at the first one, we obtain just the same LAUE spots only displaced on the photographic plate with respect to the former spots. This process is repeated several times, until the whole wire is examined. If it is fairly well monocrystalline all LAUE spots will lie on straight lines parallel with the direction of displacement (fig. 1). If however the wire is but slightly twisted, a displacement of the wire changes the orientation of the lattice with respect

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[1]) BRIDGEMAN, Proc. Amer. Acad. of Arts and Sc. **60**, 305, 1925.

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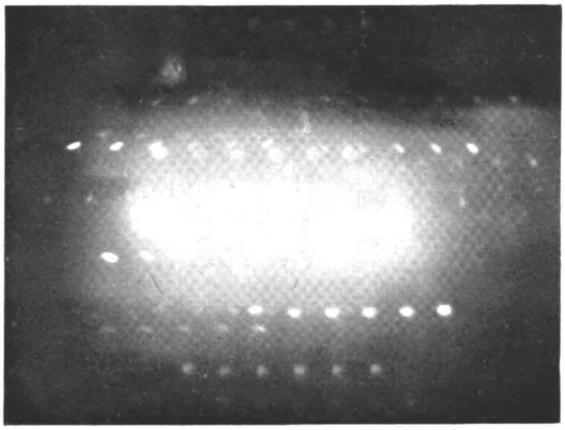

Fig. 1.

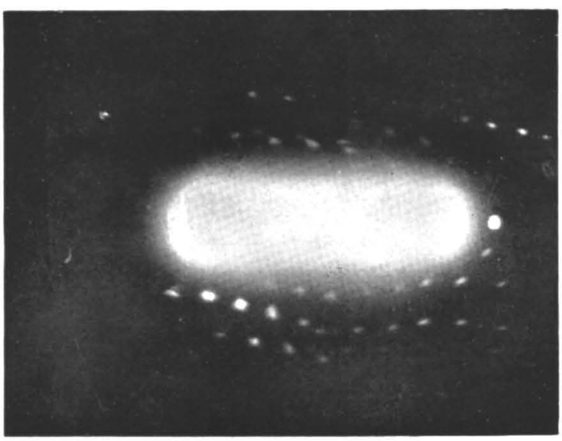

Fig. 2.

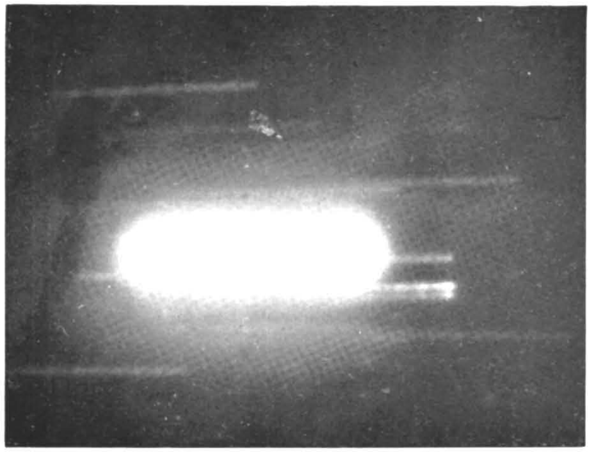

Fig. 3.

Fig. 4.

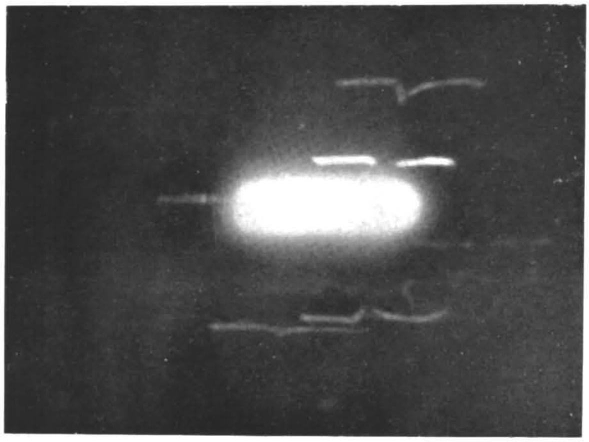

Fig. 5.

to the incident beam, so that the LAUE spots do not lie any longer on straight lines (fig. 2).

The experiments. In the way usual in resistance measurements the wires are mounted without tension on small pieces of ivory (fig. 6). Through a slit in the ivory a beam of RÖNTGEN rays can fall on the wire (BOUWERS tube of PHILIPS 90 KV., 10 mA, tungsten anti-cathode).

Both the wire, which is placed horizontally, and the photographic film are mounted on a sledge which can be moved horizontally by means of a screw. By the use of accelerating screens before and behind the film, the exposition time is reduced to one minute. This renders it possible to move wire and film continuously (1 mm per min.). Instead of spots we now obtain lines (fig. 3) which must be parallel.

When however the monocrystalline wire is displaced not exactly parallel to the photographic film, the lines are a little convergent. This deviation from parallelism however is easily distinguishable from that caused by a torsion of the wire.

Results. Cooling down the wires to the temperature of liquid helium was proved not to disturb the monocrystallinity. On the other hand the wires were found to be very sensitive to mechanical perturbations, so that they must be treated with the utmost care. As an example the wire of fig. 3 which was 4 cm long, was bent out in the middle over 1 mm and pushed straight again. Visually no disturbances could be detected, but in the RÖNTGEN photographs they are prominent (fig. 4).

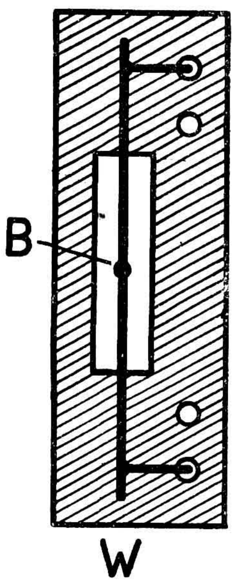

Fig. 6.

We also investigated in how far the soldering of a potential wire caused disturbances. For this purpose we soldered a small sphere B of $\pm$ 1 mm diameter to the middle of a good tin wire W (fig. 6). The monocrystal was found to be disturbed in loco, while the wire was proved to be twisted over a length of 1 mm at both sides of the soldering point. This conclusion could be drawn from the interruption and the bending out of the LAUE lines (fig. 5).

The above described both simple and quick method to test monocrystalline wires may be of use in the great number of investigations for which monocrystalline wires are wanted.

The wires used in the above experiments were made and mounted by Mr. J. VOOGD, to whom we gladly express our thanks for this work.