

with Miss H. E. Millar, had previously made the same observations as Messrs. Sutton and Willstrop. In our experiments, and employing the same method, it was even possible to notice the film on such thin foil as 0.00075 in. in thickness, and moreover we were able to identify surface markings on the layer which were originally present on the original metal. Messrs. Sutton and Willstrop are probably unaware that we had previously made this observation, and therefore the correctness of our conclusions becomes the more certain.

W. H. WITHEY.

The National Physical Laboratory,
Teddington, Middlesex,
May 17.

WE are glad to have been given the opportunity of reading the letter from Mr. W. H. Withey. We had already read the paper by Mr. Withey and Miss Millar with much interest, and had spent a good deal of time in an attempt to interpret their results. These appeared to us to indicate that the material of their sheet No. 1 was free from both internal and superficial oxide; that rolling sheet 1 down from 0.01 to 0.006 in. in thickness produced a film thicker than that which we have so far found present on aluminium which has stood over long periods exposed to air, and that later rolling reduced the thickness of the film as well as that of the metal to a value much below the normal, assuming equal density of the films.

It appeared to us possible that under the very high pressure exerted by the rolls, the metal may attain a very high temperature locally and oxidise rapidly in the same way in which, for example, steel is known to do in an overloaded ball race, but that the oxide film formed in the early stages of rolling may obstruct further superficial oxidation during subsequent rolling. We do not know whether Miss Millar and Mr. Withey have any further results which would throw light on this matter or whether they would regard this tentative explanation as a reasonable one.

Accepting the results of Miss Millar and Mr. Withey regarding film formation in rolling, of which we have no experience, our experiments have so far indicated that by long standing in air, a surface film is formed of three to five times the thickness of that present on their finished sheet, but at present our experience has been confined to thin sheets. Also, the directly observed increase in weight of aluminium standing in air, recorded by Dr. Vernon in the second report to the Atmospheric Corrosion Research Committee, corresponds to about twice the thickness of film present on the finished sheet of Miss Millar and Mr. Withey, assuming the films to have the same composition.

H. SUTTON,
J. W. W. WILLSTROP.

Metallurgical Department,
Royal Aircraft Establishment,
S. Farnborough, Hants,
May 31.

Etch Planes in Metallic Single Crystals.

It is well known that when an etching solution is applied to a metallic crystal, the action takes place so as to leave the surface 'stepped' in such a way that optical reflection takes place from planes in the crystal which are definitely related to the crystallographic axes. We have investigated this relationship with single crystals of iron, nickel, and aluminium.

The iron crystals were etched with a 10 per cent. solution of nitric acid in alcohol, and the nickel ones with concentrated ferric chloride solution. We have obtained very good etch patterns on aluminium by treating first in caustic soda and then with ferric

chloride solution. This process appeared to give a better contrast etch than the ordinary treatment with caustic soda alone.

The apparatus for locating the etch planes by means of the optical reflections consisted simply of a crystal goniometer mounted in place of the prism table on an autocollimating spectrometer. The planes from which reflection takes place can be identified by measuring the angles between different reflecting facets. By setting the crystal so that a zone axis is parallel to one of the goniometer axes, the angle between two reflecting planes can be measured by a single movement of the goniometer.

In the case of iron, which is a body-centred cube, the problem appears quite simple, the etch reflections being mutually perpendicular, indicating that the planes are {100}. (See also McKeehan, *NATURE*, May 14, p. 705.) The case of aluminium (face-centred cube) is similar, except that in a few cases reflections were obtainable from {110} planes. These reflections, however, were always very faint compared with those from {100} planes. Although the structures of aluminium and nickel are similar, they etch in different ways. Davisson and Germer (*NATURE*, April 16, p. 558) state that nickel crystals etched by vaporisation develop {111} facets. Using the etch method described above, we have found that {111} and {100} facets are formed, as is shown by the fact that strong reflections were obtained in directions inclined to one another at 90°, 70°, 55°, or the supplements of these angles.

A considerable number of crystals were examined by the optical method and the measured angles were generally within 1° of the calculated values. X-ray examination by Müller's method (*Proc. Roy. Soc.*, 105, p. 500) of a number of nickel crystals gave results in agreement with the optical data. The development of two etch planes does not in any way invalidate the use of etch reflections for the determination of crystal planes, but a more thorough examination of the crystal becomes necessary to avoid ambiguity.

H. H. POTTER,
W. SUCKSMITH.

Physics Department,
The University,
Bristol, May 20.

'Active' Nitrogen.

In all the work, both theoretical and experimental, which has so far been done with regard to active nitrogen, it has at least tacitly been assumed (a) that active nitrogen is homogeneous and (b) that the afterglow and chemical activity are necessarily co-existent, although from Saha and Sur's theory of the nature of active nitrogen (*Phil. Mag.*, 118, 421; 1924), it follows that nitrogen may be 'active' and yet show no luminosity. Dr. H. W. B. Skinner has recently suggested to the author that in view of the production of H atoms, excited H₂, and H₃ by the discharge in hydrogen, it does not necessarily follow that the form of nitrogen which is responsible for the afterglow is that which is chemically active. Experimental evidence completely in support of this theory has now been obtained.

If a stream of glowing nitrogen be led through a second and weak discharge, the luminosity is destroyed or very considerably diminished, as described by Lord Rayleigh (*Proc. Roy. Soc.*, 92, 438; 1916). The concentration of active nitrogen in the gas stream may be determined by the admission of nitric oxide to the gas below the discharge (Willey and Rideal, *Jour. Chem. Soc.*, 1926, 1804), and it has now been found that when two independent discharges are provided, one