their attention directed to the vital tasks connected with the social relations of science. Increased knowledge is needed in this field in order to weigh the value of different research projects in the industrial countries and to build up a research apparatus in the developing countries.

Social science investigations of numerous aspects of 'research' were started by English scientists in the 'thirties. That these studies did not lead further was due largely to ideological disagreement on the planning of science. To-day the chances of success are better, but occasional reflexions on the vital importance of this field will not suffice. What is needed is much hard work by a great many competent persons over a prolonged period.

SVERKER GUSTAVSSON

ADVANCEMENT OF SCIENTIFIC EDUCATION IN SCHOOLS

THE final report of the Industrial Fund for the Advancement of Scientific Education in Schools* is a brief record of a creditable episode in the history of education in the United Kingdom and Northern Ireland, which has now come to an end. The Fund was established in 1955, mainly on the initiative of Lord Weeks, Sir Alan Wilson, Mr. J. Oriel and Mr. G. Courtauld. Its object was to give a boost to the supply of scientists and technologists. Contributions were received from 141 industrial concerns, and the total sum accumulated amounted to £3,211,035. From this sum grants amounting to £2,640,500 were made to 210 schools for the renovation and extension of buildings for science teaching, and 129 schools received assistance for obtaining apparatus. Among the smaller items, a sum was set aside for the publication of a book on the planning and equipment of laboratories, based on experience acquired through the Fund; seven schools were given an engine test bed; and a special grant was allotted to Malvern College where, through aid provided by the Nuffield Foundation, new approaches are being made to the teaching of physics. Assistance was limited to independent and direct-grant schools for boys and girls, since maintained schools are the concern of the Government and Local Education Authorities; throughout the duration of the scheme interest was concentrated on the 'exact' sciences, so that the teaching of biology benefited only indirectly.

In attempting to assess the success of the scheme it is not possible to arrive at precise conclusions because of the interplay of a variety of factors. But one point not mentioned in the report is that the Fund must have been a great boon to the schools concerned in a post-war period of economic and personal austerities. Since 1955, the number of sixth-form members specializing in mathematics and science has greatly expanded; it is now common practice for all boys to be taught some science before taking the Ordinary Level Examination of the General Certificate of Education, and many schools have organized courses in science for arts specialists.

Only in the fourteen girls' schools which received grants have the results been disappointing. In them, staffing may have been a more difficult problem than lack of facilities; and apart from medicine and its associated services, girls and headmistresses alike do not look favourably on careers in science. Yet the few girls who do take science at the Advanced Level of the General Certificate of Education do well in it and particularly well in biology.

Other questions are posed by the report. In some boys' schools the "express line" of preparation for the Ordinary Level Examination of the General Certificate of Education is producing an increasing number of boys spending a third year in the sixth form, which would seem to be undesirable. Again, in recent years arts specialists have been increasing about twice as fast as specialists in science; in fact, recently in the larger public schools the number of science specialists has tended to fall, suggesting that science is not appealing to some of the most able boys. That in turn may have some relation to the limited amount of science being taught in preparatory schools, although in them there has been some improvement over the past few years. Finally, to the credit of the Fund it can be said that the standard of accommodation for teaching science which it provided was higher than that envisaged by the Ministry of Education in its *Building Bulletin* No. 2A, 1954, while the standard of equipment in maintained schools continues to give grounds for concern in relation to the place of science in the modern world and the extent to which teachers become discouraged and frustrated by present conditions.

* Report on the Industrial Fund for the Advancement of Scientific Education in Schools. Pp. iii+36. (Barbary, Marcsfield Park, Uckfield: Sir Graham Savage (Chief Assessor), 1964.)

ANISOTROPY OF FRICTION IN CRYSTALS

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EARLIER experiments in this laboratory have shown that the friction of diamond is dependent on the crystallographic direction of sliding[1,3]. With a diamond slider (of constant orientation) sliding at low speed on the cube face of a polished diamond the coefficient of friction was $\mu = 0{\cdot}15$ when sliding in the [100] direction (parallel to the cube edge) and $\mu = 0{\cdot}05$ in the [110] direction (diagonal to the cube edge). Frictional anisotropy has also been observed on other crystals, for example, sapphire[4] and copper[5].

Magnesium oxide. We have recently examined the frictional behaviour of single crystals of magnesium oxide. This is a convenient crystal since it cleaves readily on the (001) face to give a flat surface and the techniques for examination by chemical polishing, dislocation etching and electron microscopy are well established. With a hemispherical slider moving at low speed (0·1 mm/sec) on a cleaved face in air under a load of 30 g the coefficient of friction was $\mu \simeq 0{\cdot}2$ and appreciable plastic deformation occurred beneath the surface of the crystal. This is illustrated by Fig. 1. There are two major features revealed by this photo-micrograph. First, the processes of fracture which govern the formation of wear debris occur both on and beneath the surface. Secondly, slip has taken place predominantly on those (110) planes which intersect the deformed surface at 45°, although some slip on those (110) planes at 90° to that surface is revealed. The maximum shear stress, under these conditions, is at a point below the surface and it is from this region that the dislocation loops originate and multiply. Similar deformation has been observed under conditions of rolling friction[6].

A crystal of magnesium oxide exhibits a marked anisotropy in its mechanical properties. Measurements of hardness, for example, show that this is very dependent