From a variety of sources the author has collected a considerable amount of information into a small compass, and the lay reader may rely upon finding sufficient information for his purpose concerning our indigenous medicinal and poisonous plants. That inaccuracies occur here and there must be admitted; they appear to be due to insufficient verification on the part of the author, and their presence is not surprising when one considers the number of conflicting statements that have been recently made on the subject. Should a second edition be called for, these might be avoided by submitting the proofs to an expert for critical revision, and blemishes thus be removed from a useful little work.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

The Colours of the Striæ in Mica.

ON examining even the most regularly split and transparent pieces of mica by diffuse reflected light, a few fine hair-like and rather irregular lines may generally be seen running along the surface. We have found that these lines or striæ show some very interesting effects when mica is examined in a Töpler "Schlieren" apparatus. The sheet as a whole, being optically good, remains invisible, but the striæ shine out as brilliant and vividly coloured lines of light, the colours being different for different striæ, and changing in a remarkable manner as the inclination of the mica relatively to the direction of the light in the apparatus is altered. For instance, a stria at normal incidence may appear crimson and, as the mica is rotated about an axis in its own plane, become successively purple, green, yellowish-green, yellow, orange, scarlet-red, green, yellow, and red.

The phenomenon is being investigated in detail by one of us (P. N. Ghosh), but as to its general nature there appears to be little doubt. The striæ are lines at which the thickness of the mica changes in a discontinuous manner, and the luminosity is due to the radiation from the discontinuity acting as a laminar diffracting boundary. For any particular wave-length the radiation is zero if the retardation of the wave-front on either side of the discontinuity differs by an even multiple of half a wave-length, and is approximately a maximum if the difference is an odd multiple of half a wave-length. The detailed mathematical investigation would follow the general lines indicated by Lord Rayleigh in his theory of the Foucault "knife-edge" test (*Phil. Mag.*, February, 1917).

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September 5.

PROBABLY the striæ, regarded by the authors as boundaries between regions of slightly different thicknesses, are the same lines as can be seen by reflections of soda light, as described in my note on "Regularity of Structure in Actual Crystals" (*Phil. Mag.*, vol. xix., p. 96, 1910). Doubtless the Foucault method shows them in a more striking manner, and, in any case, the colour effects are novel, so far as I know, and worthy of a closer examination.

RAYLEIGH.

SELF-CONTAINED MINE RESCUE APPARATUS.

MOST people are now more or less familiar with the development of the Army respirator from its crude form of a cloth pad to the scientific and efficient "box respirator" used to-day. This is just one example of the many applications and developments of science during the past few years. In mining work the need for the construction of apparatus on scientific lines is being more and more realised, and this is especially so in the case of mine rescue apparatus. When these are employed, whether for actual saving of life, for recovery work after some serious explosion, in dealing with mine fires, or for any other use in an irrespirable atmosphere, it is imperative that the apparatus should be so constructed that the wearer may absolutely rely upon it to last for the period and work required. In the past, unfortunately, too many different types of apparatus have been put on the market without undergoing a thorough and scientific testing, and as a consequence in several cases their use has been attended with fatal results.

The "box respirator" is designed to withdraw, or render innocuous, small quantities of highly toxic gases or vapours, thus leaving the air for the wearer to breathe practically harmless. Certain gases are, however, not readily absorbed by the ordinary form of Army respirator, and of these carbon monoxide is notable. The highly toxic action of small quantities of this gas mixed with air renders the use of an apparatus of the type of a self-contained mine rescue apparatus essential, and for certain classes of work at the Front, where dangerous quantities of carbon monoxide are met with, such apparatus has been largely employed.

The recent report of the Mine Rescue Apparatus Research Committee[1] should prove of interest, therefore, not only to the mining community, but also to many members of his Majesty's Forces. In May, 1917, the Advisory Council for Scientific and Industrial Research appointed Mr. W. Walker (Acting Chief Inspector of Mines), Dr. H. Briggs, and Dr. J. S. Haldane as a Committee "to inquire into the types of breathing apparatus used in coal mines, and by experiment to determine the advantages, limitations, and defects of the special types of apparatus, what improvements in them are possible, whether it is advisable that the types used in mines should be standardised, and to collect evidence bearing on these points."

Recent advance in our knowledge of the physiology of breathing, largely due to the work of Dr. Haldane, and the latter's practical tests on various types of mine rescue apparatus at Doncaster during the past few years, together with those carried out by Dr. Briggs (for the Research Committee) at Edinburgh, have given the Committee a sure foundation upon which to build its report.

[1] First Report of the Mine Rescue Apparatus Research Committee. (Published for the Department of Scientific and Industrial Research by H.M. Stationery Office.) Price 1s. 9d. The illustrations which accompany this article are reproduced from the Report by permission of the Controller of H.M. Stationery Office.

As a result of these and other experimental tests, and of visits to various mine rescue stations throughout the country, the Research Committee is able to make a number of valuable suggestions and recommendations in the first report, with the object of increasing the safety and efficiency of both apparatus and wearer.

In the report attention is directed to the serious defects in existing apparatus, and the lines along which improvement is desired are indicated. Tribute is paid to the pioneer work of Mr. H. A. Fleuss, the designer of the first oxygen mine rescue apparatus. The photo of which Fig. 1 is a reproduction shows Mr. Fleuss and a group of miners equipped with this apparatus, and it is of especial interest in that it records the first application of such apparatus in mining. The photo was taken at the time of the underground fire which followed the explosion at Seaham Colliery, 1880–81. The excellent work of Sir W. E. Garforth (designer of the "Weg" apparatus), Sir John Cadman, and others, in increasing the efficiency of oxygen apparatus, is referred to, and also that of Col. Blackett and Mr. Mills, of Newcastle, in connection with liquid-air apparatus.

FIG. 1.—Henry A. Fleuss and group of miners, equipped with earliest Fléuss apparatus and oxygen lamps. Seaham Colliery, 1881.

Only the so-called two-hour types of apparatus have been dealt with. These may be divided into three classes:—(1) Those in which the oxygen supply is derived from a cylinder of the compressed gas; (2) those in which the oxygen is derived from the evaporation of liquid air; (3) those in which the oxygen supply is produced by the chemical action of water vapour and carbon dioxide on oxylith ($KNaO_3$).

The report shows that the compressed oxygen type is most favoured in this country, there being 1720 apparatus of this type in use compared with ninety-six of the liquid-air type, whilst class 3 has hitherto not been employed here. For those who are not acquainted with mine rescue apparatus a description of a compressed oxygen type may be of interest. The apparatus about to be described is the "Proto" (which is the development of the original Fleuss apparatus). The description is quoted from the report:—

The apparatus has the merit of simplicity. The circulation is dependent on the lungs of the wearer, breathing being entirely through the mouth. The cylinders B together hold 280 litres of oxygen under a pressure of 120 atmospheres. The reducing valve C (Fig. 4), when correctly adjusted, allows a constant flow of oxygen of 2 litres a minute to pass into the breathing circuit. The makers also supply reducing valves, which can be set by the wearer to give discharges ranging from between 0·6 and 3 litres per minute. The oxygen passes through a flexible tube F running over the wearer's left shoulder, and enters the bag at N, where it joins the air being drawn into the lungs. Light mica valves are fitted in the tubes at M and L to control the direction of the flow of the air. The breathing-bag, which is of rubber, is divided into two compartments by a partition reaching nearly to the bottom, and in the bottom of the bag is placed a charge of caustic soda weighing 3 to 5 lb. Either stick-soda is employed or coke nuts coated with caustic. The air, in travelling from one compartment of the bag to the other, has thus to find its way through the soda, and in doing so the carbon dioxide is absorbed. By shaking the bag from to time, new surfaces of the absorbent are exposed to the air, and the absorption of carbon dioxide is facilitated. A saliva trap Z is fitted under the exhaling tube. The pressure gauge, which is carried in a pocket in front of the bag, is connected to the oxygen supply by means of a highly flexible metal tube W. The wearer can thus read his own gauge. A relief valve, operated by the wearer, is placed in the bag at K. Fig. 4 shows how, by means of a strong steel neck, the main valve wheel H is brought to the front within reach of the wearer.

A by-pass short-circuits the reducing valve C. Oxygen can be discharged through the by-pass by opening the cock I. V is the pressure-gauge valve. It is opened only when the gauge is to be read. The weight of the apparatus is about 36 lb. Needless to say, the heavy oxygen cylinders are responsible for the greater proportion of this.

Other types of compressed-oxygen apparatus differ considerably in detail from the "Proto" apparatus just described. For example, in the Draeger (German) and Meco (English) an artificial circulation of air through the apparatus is produced by admitting the oxygen through an injector nozzle at a constant rate, an air circulation of from 50 to 60 litres a minute being thereby induced, independent of the lungs.

Face-masks, in place of the mouthpiece shown in the illustrations of the "Proto" apparatus, are sometimes supplied. Experimental tests on these have shown that they are a source of grave danger to the wearer, when in a poisonous atmosphere. Consequently the Research Committee in its report advocates the complete abolition of such in favour of the mouthpiece. With a "face-mask" or "half-mask," the injector principle, of having a good artificial flow of air always passing the mouth, is essential. Otherwise an excessive amount of carbon dioxide soon accumulates in the mask, with the result that the efficiency of the wearer is seriously affected. Various other minor advantages have been claimed for the injector type, but it has so many dangerous drawbacks that the Research Committee strongly advocates the complete abolition of the injector in any apparatus.

All the main types of apparatus, with their advantages and defects, are discussed at length in the report. The difference in method of purification of the expired air may be referred to briefly here. In the case of most compressed oxygen apparatus the purification is effected by passing through a metal cartridge or purifier containing granulated soda, potash, or both. The expired air thus passes through the purifier before reaching the breathing-bag. Considerable heat is developed by the action of carbon dioxide and moisture upon the regenerating agent, and in the case of the "Proto" apparatus, in which the alkali is actually contained in the breathing-bag itself, the heat produced is not easily dissipated, owing to the non-conducting character of the rubber bag. The temperature of the inspiratory air becomes then, under certain conditions of working, almost unbearable. The trouble, however, with the average cartridge that has been put on the market in the past is that it has been totally inadequate to perform the work claimed for it by the makers, and in consequence lives have in many cases been endangered by the use of such apparatus.

To give an example of an apparatus coming under class 2—*i.e.* where the oxygen supply is derived from liquid air—the description of the "Aerophor" may be quoted from the report. There are quite a number of these apparatus in use in the United Kingdom, and with further research and improvement they should be capable of doing very good work. The "Aerophor" is shown in Figs. 5 and 6.

FIG. 2.—Proto apparatus, front view.

FIG. 3.—Proto apparatus, side view.

The receptacle A, holding the charge of 8 lb. or 10 lb. of liquid air (which in practice always contains more than 60 per cent. of oxygen), is carried together with the purifier U on the wearer's back, while the breathing-bag B is at the front. To prevent the wearer being affected by the extreme cold of the pack, the canvas jacket which supports the apparatus is padded at the back with felt, and an air-space is left between the padding and the pack. At the Northumberland and Durham stations the half-mask is employed, while at the Rotherham station—where the accompanying photographs were taken—the mouthpiece is used. The absorbent material within the metal receptacle is asbestos wool. To charge the apparatus liquid air is poured in from a large Dewar storage bottle into the pack, and a spring balance from which the pack is hung measures the charge. The receptacle is insulated by kieselguhr, felt, and a final cover of leather. The insulation permits the penetration of sufficient heat to volatilise the liquid air at the required rate. During the earlier part of the period of use the volume of volatilised air passing out of the tube from the pack is more than enough to supply the wearer's requirements. The current at this stage divides at J (Fig. 6), one part going to the lungs and the other passing to waste through U (the purifier) and the automatic relief valve R. The exhaled air also discharges through R. Later in the period, when the evaporation is less rapid, the lungs can only get the volume they call for by re-breathing

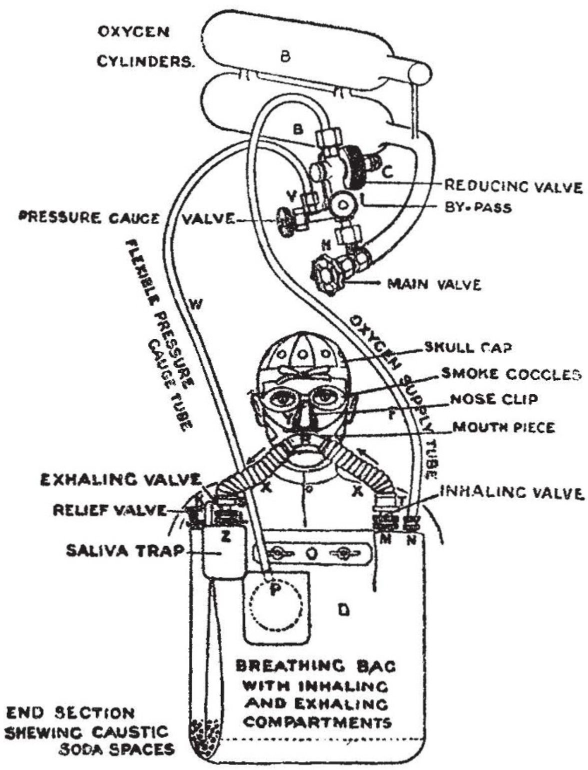

FIG. 4.—Proto apparatus, flow diagram.

a portion of the exhaled air. The flow in the purifier now reverses; the apparatus becomes a regenerator, and the purifier removes the CO_2 and moisture from that part of the expired air returning to the bag. In the Newcastle model the purifier is larger than that illustrated. An attachment is provided consisting of a length of flexible tube ending in a mouthpiece and relief valve. By connecting this tube to R, it may be possible during the first part of a two hours' interval to supply air to another man. This apparatus, weighing about 30 lb., is somewhat lighter than most of the compressed oxygen types.

The third class of rescue apparatus is unlike any of the others. In this case the oxygen is produced, and the air regenerated, by causing the products of expiration to pass through a cartridge of oxylith (potassium-sodium peroxide). This substance is attacked by carbon dioxide and water vapour with the liberation of about the same volume of oxygen as the carbon dioxide and water contain. The apparatus has hitherto not been successful, owing to its excessive resistance and the heat developed. Its small weight (about 15 lb.) is its chief advantage.

Another interesting point brought out in the report is the necessity for the use of pure oxygen. To the average man it would seem that oxygen showing 90 per cent. of purity should be amply sufficient for breathing purposes. One must remember, however, that in a self-contained apparatus the oxygen is being consumed, whereas the impurities—mainly nitrogen—tend to accumulate. For example, if a "Proto" apparatus is being used in which the oxygen contains 10 per cent. of nitrogen, and the wearer is doing work necessitating the consumption of 2 litres of oxygen per minute—the "blow off" valve not being used—then after about three-quarters of an hour the percentage of nitrogen in the breathing-bag will have increased to about 90 per cent., the oxygen being only 10 per cent. The wearer persisting in his work would quickly become unconscious. The purity of the compressed-oxygen supply is therefore of great importance, and the Research Committee lays stress on the necessity for having every

FIG. 5.—Aerophor apparatus, front view.

cylinder of oxygen arriving at a rescue station sampled and analysed. It advises, for use *underground*, only such cylinders as contain 98 per cent. or more, and for surface work (practices, etc.) such as contain more than 97 per cent. The danger of hydrogen in electrolytically prepared oxygen is also pointed out.

The Committee recommends the prohibition of the use of any breathing apparatus in mines under the Coal Mines Act unless the apparatus be "of a type for the time being approved by the Secretary of State." The necessity for this is very evident to anyone who has had practical knowledge of the very serious condition in which some apparatus is supplied, and for which the makers are entirely responsible. The Committee also proposes that an inspector should be appointed "to

FIG. 6.—Aeropnor apparatus, back view.

advise the Chief Inspector of Mines as to the safety of these apparatus," and to see that the regulations regarding rescue operations are properly carried out.

Many other interesting and valuable recommendations are made; the dangers of existing apparatus and means for overcoming these are pointed out, and the training of rescue brigades, methods of signalling, etc., described. The report is most instructive and interesting, and will well repay time spent in its perusal.

In most districts the rescue teams are composed of volunteers from each pit—men who are willing to risk their lives in the work of rescue or recovery in the event of any form of mine disaster. Work in our coal mines at the best is always attended with a certain amount of risk to life and limb. After an explosion or fire this risk is increased considerably. It is only just, therefore, that the construction of the apparatus itself should be such as to involve the least possible risk to the wearer, and that claims made by makers for their apparatus should be capable of complete justification.

The work of the Mine Rescue Apparatus Research Committee and the publication of its reports will be one of the best means of realising this aim.

J. I. G.

INTERCHANGE OF UNIVERSITY STUDENTS.

WHEN in March last Mr. Balfour proposed that a mission consisting of representatives of the universities of the United Kingdom should be sent to the United States, he did the cause of university education notable service. To the members of the conference convened at the Foreign Office, Mr. Balfour described, on the basis of his own recent experience, the influence which university opinion carries in all matters of policy, whether domestic or international, of our great Ally. He then laid emphasis upon the need for the creation by British universities of opportunities of corporate expression. He advocated the establishment of a representative body which would be able to speak for the universities as a whole.

To the conference which had already been called for the next day by the Universities Bureau of the British Empire was remitted the responsibility of selecting a group of men and women to visit the United States. The "Balfour Mission" reached the far side of the Atlantic some two or three weeks ago. Accounts of its proceedings and of the distinguished welcome which the delegates are receiving in all the chief universities of the American continent on both sides of the border have appeared in the papers from time to time.

Acting upon Mr. Balfour's suggestion that our universities should find means of giving expression to their collective views, a Standing Committee, consisting of all their executive heads—vice-chancellors or principals, as the case may be—was appointed by the conference for purposes of consultation and mutual counsel. Whether in constitution this committee remains as at present, or whether in the future some other and more direct method of selecting its members be devised, the universities have, through the delegates whom they sent to the conference, agreed to the institution of "a Senate of the Senates," to use a phrase adopted by Mr. Balfour. They have taken a step which is likely to have a profoundly important effect upon their usefulness and prestige.

One of the main objects of the mission is to promote interchange of students. In the Middle Ages a student was free to migrate from one university to another in search of the most eminent teachers of the faculty of his choice. Like his professors, who had by graduation secured their *jus ubique docendi*, he was matriculated in the