5·8 and 16·6 per million. In the natural tobacco on which no work had been expended before the tests were applied, the amount varied from 25 to 250 parts per million. The data refer to tobacco grown in the Argentine and worked up in its factories, with the exception of some specimens which contained mixtures of imported tobacco, and all the data refer to the types of cigars and cigarettes which find their way into the market. The danger of arsenic poisoning from tobacco is obviously very small.

MAGNETO-STRICTION NOISE FROM TELEPHONE WIRES

WHEN magnetic material is subjected to a mechanical force, its magnetization is changed; and conversely, if its magnetization is changed, the material expands or contracts. There is thus a relationship between the stress and magnetization of magnetic materials which is called magneto-striction. According to an article by M. T. Dow (*Bell Lab. Rec.*, **22**, No. 10; June 1944), noise encountered some eight years ago on certain telephone lines was found to be caused by vibrations set up by wind in a long river-crossing consisting of steel conductors, and experiments indicated clearly that the noise was due to magneto-striction. The alternating stresses in the taut wires vibrating under the influence of wind, resulted in corresponding changes in the magnetization of the steel wires, and these magnetic fluctuations induced voltages in the wires that appeared as noise at the ends of the line.

Since the voltages induced by magneto-striction vary at rates which depend on the rates of change of stress in the wire, the noise frequencies are related to the frequencies of vibration of the wire, and these in turn are determined largely by the size of the wire and the velocity of the wind; wire tension, span-length, and other such factors also have some effect. It was found that practically all frequencies of the magneto-striction noise were in the voice range, and under certain conditions the dominant frequency was in the neighbourhood of 1,000 cycles/second, which is the range producing the greatest disturbing effect. The test results confirmed a simple relationship expressed as $f = 7(v/d)$, where f is the principal noise frequency in cycles/second, v is the wind velocity in m.p.h., and d is the diameter of the wire in inches. To produce a 1,000-cycle noise, therefore, the wind velocity is given by the expression $v = 143d$. Commonly used copper-steel wires are of 0·104 in. and 0·128 in. in diameter, and for these two sizes the wind velocities to give 1,000-cycle noise are about 15 and 18 m.p.h., respectively. These are velocities commonly encountered.

For the same velocity of wind, the greatest effect is experienced when the wind is approximately at right angles to the direction of the wires. Taut wires with sags of less than 8–10 in. in 130 ft. spans favour the generation of magneto-striction noise. Fairly steady winds with velocities around 20–35 m.p.h. produce the highest values of noise. Winds in this range of velocity favour the building up of resonance, which leads to high amplitudes, and also are likely to produce frequencies of the greatest disturbing effect. Turbulent winds, with velocities up to 64 m.p.h., seem to inhibit the building up of resonance, and thus are less effective in producing noise. The effect is greatest in all-steel wires, and becomes less the greater the relative amount of copper.

An estimate based on a study of the results obtained indicates that for tight wires, in an exposure of 25 miles or more in length where conditions favour magneto-striction noise, the unamplified noise generated during windy periods would probably average around 28 db. above reference noise. Occasionally, maxima might reach as high as 36 db. above reference noise. Both these figures are for tight, copper-clad wire of 40 per cent conductivity; the corresponding figures for wire of 30 per cent conductivity would be about 3 db. higher. Under similar conditions, the noise for all-steel wire is likely to be 10–25 db. higher. Actually, while magneto-striction noise has been experienced with steel wire, none has ever been reported on circuits employing copper-clad wire.

USE OF 'POLAROID' FOR THE MICROSCOPE

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FILMS of very strongly pleochroic material, usually mounted between glass plates, have been available during the past few years under the trade-name 'Polaroid'. For some purposes they can replace the nicol prism, but their use has been restricted because in a moderately strong light they transmit a noticeable reddish-violet colour at the position of extinction.

Disks of improved 'Polaroid' of high optical quality have since been made, and a British firm of instrument makers recently placed two of them at the disposal of H.M. Geological Survey for investigation of their possible use in the petrological microscope. The following is a brief report, communicated by permission of the Director, Geological Survey and Museum, on their properties, which rival those of the best nicol prisms.

Extinction. It has been understood that 'Polaroid' was prepared by the alignment of small pleochroic crystals in an artificial preparation. Consequently one might expect that the extinction would be less sharp than that for a nicol prism, and that a small proportion of the strongly absorbed ray would still be transmitted. For the pair of disks now to be described both these fears proved groundless.

Fig. 1 shows two examples from several curves that were measured by means of a visual microphotometer, similar in purpose to that of M. Berek, which I hope to describe shortly. One nicol (or 'Polaroid') was fixed in the usual position in the microscope, while the other was placed on the rotating stage, which could be read to 0·1°. Stray light was excluded by means of black paper tubes. With a strong beam it was possible to obtain a variation of 100 units on the photometer scale within a rotation of ± 2° from extinction. Curve *A* is the ordinary extinction curve for two nicol prisms; there is good agreement between the photometer readings (shown by circles) and the continuous curve calculated from the usual formula, indicating that the photometer scale is practically linear. The readings along curve *B* were obtained with two 'Polaroids'; they again show substantial agreement with the corresponding calculated curve, even for the range nearest extinction.

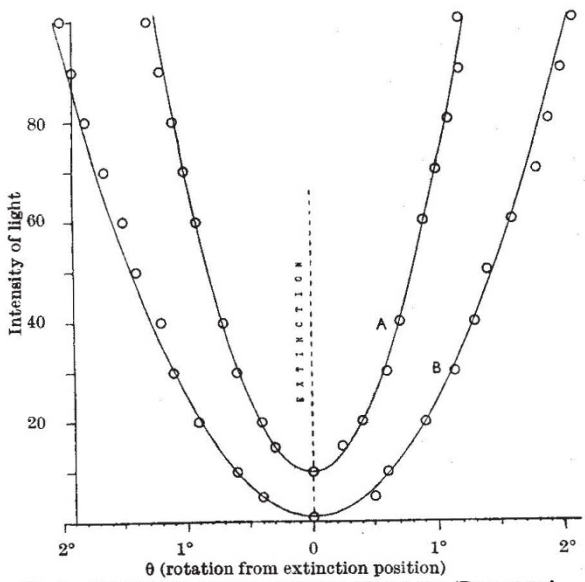

Fig. 1. EXTINCTION CURVES FOR NICOL PRISMS AND 'POLAROIDS'. O, Photometer readings; full curves calculated from $\sin^2\theta$.

The intensity at extinction is not seriously different from that indicated by the curve drawn through the other readings. This curve was fully confirmed by a repetition with rather more residual light, so that the readings were from 10 units upward on the photometer scale. If the calculated curve is extrapolated to give the approximate photometer reading when the nicols (or 'Polaroids') are parallel, the percentage of residual light at the extinction position can be obtained; it is very low, being 0·0052 per cent for curve *A* and 0·0015 per cent for *B*. It follows that the absorption of the strongly absorbed ray in this 'Polaroid' is practically complete. When the sun or a lamp filament was examined directly through the crossed 'Polaroid' disks, the transmitted beam had a lilac colour, but in front of a microscope lamp it was too weak to be distinguished.

The residual light seen at extinction in the microscope, whether with nicols or 'Polaroids', is almost completely polarized by the analyser; it is thus to be assigned chiefly to the diffusion of light at the surfaces (or the admission of stray light) between the polarizer and the analyser. This is readily tested by examining the field at extinction through an additional nicol; light transmitted owing to the inadequacy of the analyser itself would be polarized at right angles to the above. The low value of the residual light in curve *B* is due to the relative ease with which the 'Polaroids' can be enclosed, and the small number of surfaces; it gives satisfactory evidence of the absence of cloudiness in the 'Polaroid' itself.

Definition. The 'Polaroid' disks can be made optically flat. When one was inserted in a microscope instead of the analysing nicol, the lateral displacement of the image was inappreciable and there was no apparent loss of definition. The slight displacement of focus due to the thickness of the glass was also practically negligible; if necessary, it could be completely compensated by placing a blank glass in the space usually left vacant.

Absorption of light. 'Polaroid' has a neutral smoky tint; measurement by the visual photometer showed a transmission of 32 per cent for green light, and later measurements gave 34 for green and 36·5 for a 'tricolour red' screen. In order to obtain a more complete determination of the absorption for the visible spectrum, the 'Polaroid' was submitted to Dr. J. McClelland at the Government Laboratory, and the following report is communicated by permission of the Government Chemist.

"The 'Polaroid' plate was fixed in front of the slit of a constant deviation glass spectrograph at right angles to a beam of light from a tungsten lamp, and rotated so as to transmit the maximum amount of light. Photographs were taken by the usual method, with exposures adjusted to give approximate equality of the spectra with and without the 'Polaroid'; the intensity of the images was then compared photometrically in a Hilger non-recording microphotometer over a series of wave-lengths. The results, one of which is represented in Fig. 2, are remarkably uniform, with a slight increase in absorption in the blue-green; otherwise there is no evidence of any noteworthy absorption band, even toward the limit of the visible spectrum."

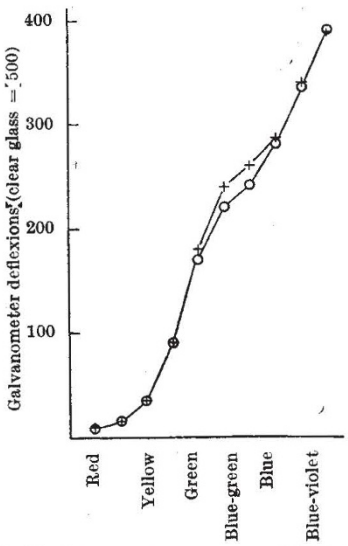

Fig. 2. ABSORPTION OF LIGHT BY 'POLAROID'. O, 'Polaroid' (75 sec.) +, Light source (25 sec.)

These results imply the substantial absence of colour in the light transmitted by the 'Polaroid'. The small differences in the spectrum fall within those commonly found in the various 'daylight' screens and other sources usually employed. Of the incident light, approximately 50 per cent is completely absorbed by the polarizing action, as in the case of the nicol prism. The transmitted beam, which in a nicol would approach 50 per cent (with a small deduction for loss at the surfaces employed), is 33 per cent in the 'Polaroid', so that there is a loss of about 1/3 in the transmitted light with one 'Polaroid' and about 1/2 with two. In practice this difference seems to be more than compensated by the greater diameter at which the condenser can work when 'Polaroid' is used instead of a nicol, by the elimination of compensating lenses and by the improved extinction that may be obtained. In any event, for transmitted light there is no difficulty in using a rather stronger source. For the ore microscope the light-source is nearer the practicable limit and the aperture is often limited on other grounds; nevertheless 'Polaroid' would seem likely to be useful for all but the most exacting work on bireflexion, and for this also if a sufficient source is available.

From the preceding brief account, it would seem that the new 'Polaroid' is likely to require most serious consideration not only for students' use but also for research microscopes. Not only is there a substantial saving in cost if the material can be supplied at a similar price to the nicol prism or lower, but improvements are also possible in the optical system and in the microscope design.

THE MELLON INSTITUTE

WAR-TIME RESEARCH

UNDER the title "The Mellon Institute in the Second Year of War", a brief summary of the activities of the Mellon Institute has been condensed from the thirty-first annual report, indicating its contribution to the war effort. During the year, March 1, 1943–March 1, 1944, a multiple industrial fellowship on chain welding and metallurgy was divided into two separate fellowships on chain welding and on powder metallurgy techniques. The iodine fellowship was revived in April, and seven other proposals for research have been accepted. The Institute's industrial research staff now consists of 201 fellows and 214 fellowship assistants. Two of these fellowships have been active for thirty years, seven for twenty-five and eight for twenty; sixty in all have concluded at least five years of research. During the year the Institute's expenditure for pure and applied research amounted to 1,652,539 dollars. A new fellowship for research in the wood-container field is concerned to improve standards and production practices for shipping containers and also to eliminate the enormous amount of wood waste in the conversion of trees to such containers of finished lumber. A fellowship has been established to improve cotton fibres by altering the chemical structure without loss of identity or workability of the fibres, and another fellowship will conduct broad basic studies of the physical and chemical properties of cotton. A new fellowship of the Copperas Co. is devoted to studies of the oxidation products of major aromatics from tars.

Nine fellowships were completed during the year; they covered air-pollution control, anti-icing, garments, naphthalene chemistry, pasteurization, pencil technology, surgical supplies, synthetic rubber and tar treatment. Work on air-pollution control was brought to a temporary end through the death of the incumbent fellow. A report has been published on studies under the synthetic rubber fellowship of the toxicity of butadiene carried out for the Rubber Reserve Co.

The Institute's Department of Research in Pure Chemistry directed its efforts chiefly towards chemotherapy. Results obtained with certain new drugs as antimalarial agents are sufficiently encouraging to warrant further research. Under a scheme promoted by the National Research Council, arrangements have been made for evaluating the anti-malarial activity of new drugs. More than eighty new drugs have been submitted for antimalarial appraisal, and efforts have been directed towards possible ways of diminishing the toxicity of chemical structures recognized as possessing anti-malarial potentialities. Investigations on problems in the preparation of cinchona alkaloid derivatives with anti-pneumococcal potency have been terminated and the results published. Prototypes of a new class of modified cinchona derivative in which the phenolic hydroxyl group of apocupreine is replaced by an alkylamino constituent have been prepared by the Bucherer reaction, but the therapeutic action was not increased. A method has been evolved for the preparation of *p*-toluenesulphonyl esters of phenols and alcohols rapidly, economically and in high yield. A publication from the Department and the Department of Chemistry of the University of Pittsburgh deals with *cis*-3 : 6-endomethylene-Δ-4-tetrahydrophthalic acid: the anhydride of the corresponding hexahydrophthalic acid has been obtained quantitatively by direct catalytic hydrogenation under high pressure. The synthesis of 3-benzoyl-nor-camphane-2-carboxylic acid by a Friedel-Crafts reaction has been worked out.

Referring to researches proceeding in the Institute under the industrial fellowships, the report states that friction losses in vaned elbows of asbestos ducts have been determined in numerous designs; and the physical and chemical treatment of gypsum, which has received very thorough investigation during the past five years, has yielded especially valuable results in 1942–43. There are eight fellowships in all in the field of ceramics. Thirteen fellowships have been concerned with metallurgical studies and the failure of restrained welds; and the destructive testing of structural joints, involving special gaskets, has received much attention. Systems have been developed for centralized filtration of machine-tool coolants and a differential solubility process for treating waste pickle-liquor is announced. A research programme on the hydrogenation, dehydrogenation, oxidation and alkylation of coal products has been widened considerably, and several new catalytic processes are under development. A new process for ethylbenzene has been put into operation on the large scale, and another investigation has been concerned with the effect of paraffins on the nitration of toluene.

In addition to basic research on the production of phenols, another group is working on the separation of cresols and xylenols from their mixtures; new naphthalene derivatives are also receiving much attention. Studies of the rheological properties of bituminous materials have been continued, and substantial progress has been made in improving fractional distillation techniques under extremely high vacuum.

Under the seven fellowships pertaining to major problems of the food industry, improvements have been effected in dehydrating prepared foods, and new knowledge has been gleaned on decolorizing absorbents, including the evolution of a new synthetic granular absorbent for the sugar industry. In the textile field, the weathering of treated fabrics used as covers over the guns of coastal defences has been investigated to secure textiles more resistant to sun, salt air, wind and rain, and new yarns have been prepared from soya bean protein alone and with viscose, as well as a synthetic textile lubricant for the woollen industry. Reference is also made to advances in processing animal fibres used in felt and the co-relation of physical properties with felt quality. *GR-S* latex has been applied commercially to the saturation of sulphite papers, with results indicating a satisfactory comparability with rubber latex-treated papers but with somewhat less tensile strength. Growing attention to cyclopentadiene has greatly stimulated research on methods for its utilization. Compounds of interest for the manu-