PROFESSIONAL CHEMISTS AND THE WAR.[1]

IT is a matter of importance to the representatives of the chemical profession that their aspect of the great coal-tar colour industry should be kept well to the fore in the Government scheme and in any other scheme that may hereafter be put forward. We desire to see the restoration of the industry to this country, and not only restored, but also permanently retained after the war. The discussions of the Government schemes in various parts of the country by dye-consuming organisations, chambers of commerce, and so forth, have all centred round political or economic questions; the vital principle, viz., adequate chemical control, has been subordinated or left out of consideration altogether. While there has been much wrangling over the question as to the method by which the industry may be established and maintained here, whether by free trade or protection, or subvention, or by any other device, the consideration of the questions whether a few years hence there will be anything in the way of dyestuffs worth protecting; whether there will be a sufficient basis of material products left for the politicians and economists and business people to wrangle over has been overlooked. It is not a purely business problem which the Government has undertaken to solve; it is primarily a chemical problem.

The conditions which have to be met if this country is to be once more the home of the colour industry are imperfectly understood by the public. Even those most concerned—those who are invited to subscribe to the capital—appear in most cases to have an idea that all that is necessary is to find the money, secure Government aid, appoint a board of business directors, and lo! the industry will forthwith spring into existence ready to cope with all emergencies. What are the facts of the case? About five hundred different dyestuffs of definite composition have been given to tinctorial industry as the products of chemical research. Of these a certain number only can be, and are being, made in this country. The total output of our factories is, at present, inadequate for the requirements of our textile industries. The first step to be taken, therefore, is to enlarge and develop existing factories so that the dyes which can be made here may be turned out in larger quantities. This necessity has been provided for in the Government scheme, and "so far so good." If the extension of the existing factories still produces insufficient supplies, new factories must be erected and equipped. That also is provided for in the scheme; but if we want to establish the industry here permanently we must look beyond all this. Where shall we be left after the war? We shall be in possession of processes for making a certain number of dyes, and the supply of their products may possibly be sufficient for the particular purposes for which they are required. But there will still be an outstanding number of other products which have never yet been made here, and for the working out of these processes no combination of "business" talent is of the slightest value. It is not a business question, but a chemical question, and it is by chemical research alone that our colour industry will be saved. The German colour industry has been built up by the utilisation of the results of research carried on in the factories and universities and technical schools for a period of more than forty years! To suppose that we can retrieve our position by starting a company the directorate of which was to consist solely of business people is ludicrous.

One feature of the new scheme which the chemical profession can view with favour is the distinct recognition of research as a necessity for the development of the industry. The Government "will, for ten years, grant not more than 100,000*l.* for experimental and laboratory work." That is certainly a concession which marks an advance in official opinion. It will be for the satirist of the future to point out that it required a European war of unparalleled magnitude to bring about this official recognition of the bearing of science upon industry. Who is to direct this research? A directorate of purely business people will certainly be incompetent; a board composed of dye users can do no more than indicate what dyestuffs were needed. True, it is proposed that the company should take powers to secure the assistance of a committee of experts, but this appears to be simply a reversion to the policy of "drift." The experts are, as usual in this country, to be subordinated and their assistance is to be invoked at the discretion of a board the members of which can have no real knowledge of the conditions necessary for producing the materials they require. Will they be competent to point out dangers ahead? The "staple products" upon which they are asked to stake their capital may a few years hence be superseded by the products of later discovery. The policy of attempting to run a highly specialised and rapidly developing branch of organic chemical industry by a company of business people with expert assistance when required is fatal if it is intended to establish the industry permanently here. The group of industries which has arisen from the products of the tar still is not going to remain stagnant after the war, and it is scientific guidance and not mere assistance that will keep them alive. It is the expert, and the expert only, who can foresee the course of development, who can keep in touch with the progress of research, and direct with intelligence the campaign against competitors. If such scientific direction is withheld, all schemes are sooner or later bound to end in failure.

To other branches of manufacture in which our dependence upon foreign products has been forcibly revealed by the war, professional chemists have been able to render considerable service. It has long been known that laboratory glass and porcelain apparatus and filter paper have been mainly supplied from abroad, and that large quantities of pure chemical reagents and of the special chemicals required for analytical or research work have borne non-British labels. This state of affairs called for prompt action, and the councils of the Institute of Chemistry and the Society of Public Analysts have acted conjointly as a committee for dealing with this matter of such vital importance to the profession. The inquiries instituted by this committee soon brought the fact that failure in the supply of laboratory glass apparatus would not only cripple the work of the chemists, but would also influence to a serious extent certain important industries the dependence of which upon supplies of suitable glass had not at first been foreseen. In connection with these inquiries, it was at a later period considered necessary, in view of the great national interests involved, that the institute should take part in giving practical aid to would-be manufacturers. For this purpose a Glass Research Committee was appointed, and is still carrying on its work. Formulas supplied by members of the committee have been made in the laboratory of the institute and submitted to the recognised tests. The experiments have perforce been carried out on a small scale, but the co-operation of a number of glass manufacturers has been secured, and the results will be tested on a fairly large scale under complete expert control. Not the least important of the glass problems is the production of a suitable glass for miners' safety-lamps, the necessary protecting

[1] From the presidential address delivered to the Institute of Chemistry on March 1, by Prof. Raphael Meldola, F.R.S.

shades for which have also been hitherto mainly imported from abroad. This particular kind of glass is of pressing importance in relation to coal-mining, and it is certainly humiliating to learn from the makers of these lamps that for glass of the required quality capable of complying with the Home Office tests, we have been so largely dependent upon foreign glass manufacturers.

With respect to the supplies of chemical reagents, the joint committee found it necessary to entrust to a special sub-committee the somewhat arduous task of compiling a list of all the commonly used reagents with indications of the standard of purity required and the tests necessary for ascertaining whether the required standard had been reached. The list has been published as a pamphlet, and has been sent to many firms and companies of manufacturing chemists with the view of ascertaining which reagents of their own manufacture they are prepared to supply. When the replies have been received the joint committee will know the requirements of the profession could be met by British manufacturers.

It is hoped that sooner or later laboratory supplies both of apparatus and materials will be entirely of British origin. The manufacturers are—in some cases at considerable cost—developing lines of industry which are of the nature of new departures for this country. It is the duty of consumers and users—in fact, of every branch of the profession—to do their utmost to encourage and support these new home industries. Patriotism and the credit of our country alike demand that, after the war, they should help those who are helping them by insisting upon having nothing but the products of British manufacture. They should not only assist in the development of these industries now, but insure their permanent retention after the declaration of peace. With the achievement of this result there would be removed the reproach that the nation which gave to chemical science Priestley, Black, Boyle, Cavendish, Davy, Dalton, Faraday, and Graham—the country which founded the coal-tar colour industry, and which had taken the lead in the manufacture of "heavy chemicals," allowed her laboratory work to be dependent upon foreign materials, and her great textile and metallurgical industries to be threatened through the stoppage of supplies from inimical countries.

LORD KELVIN'S WORK ON GYROSTATICS.[8]

V.—*Gyrostatic Theory of Elasticity.*

[*Note.*—In the explanation of steady precession, near the foot of the first column of p. 715 of NATURE of February 25, the words, "the horizontal axis A of the couple," referred to a cut, which, owing to an accident, could not be given. But Fig. 6 there printed, and repeated here on page 21, will serve instead. In that, as indicated in the small diagram at the bottom of the figure, the axis of angular momentum—the spin-axis—is to be supposed drawn towards the right, from the centre of the gyrostat along the (horizontal) axis of rotation, and the axis of the couple horizontally from the centre towards the observer. The dotted arc, marked 90°, should be continued round to the axis marked $mk^2\omega$. The angle 90° is that between the spin-axis and the couple-axis.—A.G.]

ONE other experiment I shall make with the veteran gyrostat, which has been spun again. You see that the rim carries two trunnions in line with the centre of the wheel (Fig. 10). These are placed on bearings attached to this square wooden frame; and now you see that as I hold the tray in my hands in a horizontal position, the gyrostat rests with its axis vertical or nearly so. The direction in which the wheel is spinning is shown by the arrow on the upper side. I now carry the tray round in azimuth in the direction of spin: nothing happens; the gyrostat spins on placidly. If, however, I carry the tray slowly round the other way, the gyrostat immediately turns upside down on the trunnions; and now, as I go on carrying the tray round in the same direction as before, the gyrostat is quiescent as at first; but the spin, by the inversion of the gyrostat, has been brought into the same direction as the azimuthal motion.

The gyrostat behaves as if it possessed volition—a very decided will of its own. It cannot bear to be carried round in the direction opposed to the rotation, and, as it cannot help the carrying round, it accommodates itself to circumstances by inverting itself so that the two turning motions are made to agree in direction. Again I reverse the azimuthal motion, and the gyrostat inverts itself so that the wheel turns in the same direction in space as at first.

The inversion brings into play a wrench on the hands of the experimenter. A varying couple, lasting during the time of the inversion, is required to reverse the angular momentum of the wheel in space, and this is applied to the gyrostat by the frame at the trunnions, and to the frame, because that is kept steady, by the hands of the operator. The total change of angular momentum is 2 N, where N is the angular momentum of the flywheel, and this is the time-integral of the couple.

It will be noticed that in this experiment, in which the gyrostat displays this curious one-sided stability and instability, it is affected by a precession impressed upon it from without. The system was not

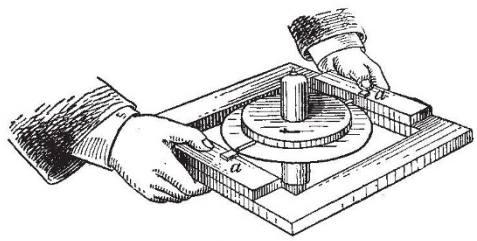

FIG. 10.

left to itself, I carried it round. The gyrostat had little or no gravitational stability—the centre of gravity was nearly on a level with the trunnions; but even if it were gravitationally unstable, sufficiently rapid azimuthal motion would keep it upright if that motion agreed with the spin, while the least motion the other way round would cause it to capsize.

It is important to notice that if the gyrostat be placed on the trunnions, so that the axis of the wheel is in the plane of the frame, azimuthal turning in one direction causes one end of the axis to rise, or turning in the other direction causes the other end to rise. As I shall show presently, this means a reaction couple on the frame which must be balanced by a couple applied by the experimenter.

Better than anything else I know, this experiment of the capsizing of the gyrostat by azimuthal motion affords an example of the two forms of solution of a certain differential equation, which, when the gyrostat is without sensible gravitational stability, and θ is small, I may write

$$A\frac{d^2\theta}{dt^2}+\omega N\theta=0,$$

where N is the angular momentum of the wheel, and ω the angular speed with which the tray was carried round. When the turnings were in the same direction, ω and N had the same sign, but when the turnings were in opposite directions the product ω N had a negative value. When the product is positive

[8] Abridged from the Sixth Kelvin Lecture, delivered at the Institution of Electrical Engineers, on January 28, by Prof. A. Gray, F.R.S. (Continued from NATURE, No. 2365, vol. xciv., p. 716.)