WITH METALLURGICAL SEC'

The Chemical Age

A Weekly Journal Devoted to Industrial and Engineering Chemistry

VOL. LIII
No. 1358

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A Weekly Journal Devoted to Industrial and Engineering Chemistry

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Organisation and the Chemist

MR. THOMAS McLACHLAN, who to the general regret has retired from the chairmanship of the London Section of the B.A.C., from the London Committee and from the Council of that body, devoted his address as chairman to a subject with which he is peculiarly identified, the welfare of the chemist. Briefly, his theme is that the chemist is insufficiently organised in any of his activities. As a result he is kicked about between the employers and the workmen's trade unions, he is not accorded the public recognition that he should have, he cannot read nor even see the mass of literature published for his benefit, and he is aloof from his fellows.

That is a pretty damning indictment; and broadly it is true. We have often wondered whether one reason for the lack of organisation is not the difficulty of defining what a chemist really is. One cannot crystallise an inherently amorphous compound. Our dictionary, which defines "chemist" as one who is "expert in, or a student of chemistry," does not help much. The fundamental difficulty is that the members of the profession are spread over many industries, and in many of those they are as far apart as they are from the geologists, the physicists, the botanists, the metallurgists, and so forth. Their several industries have little in common, their interests diverge; it is the very devil to bring them all together. But there is another and less creditable reason for the difficulty. The atmosphere of a chemist's upbringing engenders in him an unwholesome disrespect for men in other walks of life. To him, immersed in his laboratory, the engineer, the works manager, the foremen, and others come for advice on his particular field. Being, generally, the only one able to speak with authority on that subject, he is subconsciously filled with a sense of superiority. Thanking heaven that he is not as other men, he passes by on the other side. Others, including the minor lights of his own profession, become to him as "lesser breeds without the law." Secure in his castle, he refuses to combine with others, he refuses to become one of the herd, he scorns the idea of a trade union. Yet the Medicos, the Vets, the Architects, the Lawyers, and other professions have no such qualms.

No doubt what we have suggested will cause every chemist in the land to demand our blood. So we hasten to add that our diagnosis is not of

On Other Pages

general application, and that it is put forward as a suggestion for the poor support that the B.A.C. gets from the profession. Is the support really poor? Perhaps so, perhaps not; but it is yet a long way from being complete. Anything that can be done to bring chemists together will be for their ultimate good, and it is with this aim in view that we write.

It is of four "organisations" that Mr. McLachlan speaks, believing that chemists should be organised in regard to their professional duties, for security, to unify their publications, and for social reasons. He asks for chemistry to be made a closed profession with an open door for the exceptional chemist with unorthodox training. This is on the one side akin to the "closed shop" of the trade unions, and on the other to the severely "professional behaviour" enforced on the medical profession by the B.M.C. No doubt chemists might gain some advantage by restriction of their ranks, but whether that is a necessary step seems doubtful. Chemists, who, like Mr. McLachlan, are directly employed by the public as analysts, consultants, etc., could be said to have an *a priori* reason for membership of this type of organisation; but the employer firm would reap no benefit, and the employee chemist would reap exactly as much (or as little) benefit as the trade union does through the closed shop. This seems a debatable point.

The fixing of salaries on an adequate basis, and other aspects of security, are the logical field for the B.A.C. The labourer is worthy of his hire, and anything that can be done to raise his status so that he is remunerated adequately for his skill and for the work he puts in while others enjoy themselves should be done. Social security is being taken over by the Government, but on a basis totally inadequate for the staff employee. Why should not chemists and employers pay into a joint superannuation scheme for the whole profession? That would be a wonderful step forward towards social security, especially since the fall in interest rates and in the value of money makes it nearly impossible for anyone to save enough for his old age, or for his dependents when he is gone. We commend that idea for exploration to the B.A.C. Firms have such schemes, and these are actuarially sound and are undertaken, we believe, in collaboration with insurance companies.

The idea of rolling all chemical publications into one huge Journal has been the dream of chemists for some time. We are not at all sure that it is workable. It sounds very nice for the chemist to pay a single subscription and get all his professional literature, transactions, abstracts, etc., from one source. But every chemist inevitably specialises today, and we frankly cannot see much advantage to (say) the dyestuffs chemist to receive the *Transactions* of the Ceramic Society or the Faraday Society. Where should one draw the line? There could probably be some compression of societies, but new societies are not undertaken lightly; they fill a need that is not filled by an existing body. The dream that "further efforts may be made to link the various publishing societies into one homogeneous whole, to which members may pay subscriptions according to the publications they receive" seems likely to remain a dream. For ourselves we must frankly confess to have found no direct advantage in the link-up between the Chemical Society and the Society of Chemical Industry—but perhaps we are exceptional in that. Certainly it is true that "chemists on this side of the Atlantic look with envy to the great American Chemical Society, and wonder why the leading members of our great and historical chemical profession in this country are so lacking in vision that they are unable to formulate a similar idea acceptable to chemists of these isles." But that is far different from "linking the various publishing societies into one homogeneous whole."

We agree also that Income Tax rebate should be allowed on scientific literature bought by the individual chemist. It may well be that the chemist is too nebulous a person to be allowed this rebate by the Treasury, and perchance membership of a single professional organisation might be the first step towards being given the rebate. The chemist's books and technical literature are the tools of his trade, just as much as the employer's vats, boilers, and fac-

tories are his, without which he cannot continue to operate.

Lastly, social organisation; here Mr. McLachlan says what we have said many times, namely that the chemist does not mix well with his fellows because of his cloistered life, and that circumstance prevents him from making good in the larger world outside the laboratory. Mr. Churchill's early realisation of "the part played by humbug in the social life of great peoples dwelling in a state of democratic freedom" has not dawned upon quite a lot of people—but it is none the less true. We prefer to quote Mr. McLachlan, since we ourselves have already qualified by our criticism of the chemist for an early demise in a chlorine-filled gas-chamber. "My experience," he says, "is that the average chemist is a searcher after truth, and consequently tends to look at life solely from the angle of truth. If he associates chiefly with men of the same type he will seldom develop a proper business acumen and one meets far too many chemists with a decided inferiority complex." Mr. McLachlan asks that chemists should mix more with their fellows, should support their chemical societies when young, and should learn to speak in public. In a word, the young chemist must be brought forward as a normal member of society with a high position to fill.

NOTES AND COMMENTS

Salute to the Ladies

WE are most happy to announce, in our feature "Forthcoming Events," the banquet for the ladies which the Chemical Engineering Group of the Society of Chemical Industry is arranging for July 17. This "banquet," the first celebration of its kind to be organised by the Group, is to consist of a reception by the chairman and Mrs. M. B. Donald, followed by luncheon, an entertainment and tea; and the happily-chosen venue is the ancient Hall of the Worshipful Company of Tallow Chandlers in Dowgate Hill, off Cannon Street—one of the City Halls of London that was mercifully spared the fate of destruction from the air. More than that, the Group has been granted the privilege of using the Company's plate, including the Loving Cup, which will circulate in accordance with ancient tradition. We are heartily in agreement with the sentiments of the Group executives, when they state their debt of gratitude to the ladies for the arduous war-time labours they have performed. Many of these labours have been drab in the extreme; for though the women of Britain have been second to none in their readiness to share the dangers of the front line, there is a large majority whose work has consisted mainly in cleaning, queueing, mending, and the like. It was indeed a happy thought to seize this occasion of infusing a little brightness into the daily round, and our only sorrow is that accommodation makes it necessary to limit the attendance to forty couples. Still, however exclusive the entertainment must of necessity be, it is a welcome sign of the relaxation of tension which we can now all enjoy, not least those ladies in whose honour the idea was conceived.

Students' Visit to Works

IT is always refreshing to hear of a good idea being put into practice; and we were therefore extremely interested to receive an account of a visit paid by the Chemical Engineering Society of the Imperial College to the S.E. London works of the Kestner Evaporator & Engineering Company towards the end of last month. Eighteen students, divided into three parties, each under the charge of a member of the firm's senior technical staff, made a personally-conducted tour of various working demonstrations on the plant, having been previously informed of what to expect by means of a circular letter and a set of descriptive leaflets. As might have been expected, a considerable part of the demonstration consisted in the study of driers of various types, evaporators, stirrers, etc., including laboratory-scale equipment; and some of the afternoon was devoted to the process of making an acid pump in high silicon iron. This latter demonstration started

with the patterns and proceeded through the stages of moulding, casting, grinding and machining the castings, fitting and assembling the pump, and finally testing the pump. The processing of lead for chemical plant was another interesting item in the day's programme; and, before leaving, the students were given an opportunity of examining the research work in progress in the laboratory on a new system of drying by the application of a high-frequency electric current. One particularly interesting point was that the works, having been badly damaged last summer by enemy action, were not in that spick-and-span condition which is too often arranged for "outside" visitors; and the students were thereby initiated into the difficult conditions under which the industry often has to work. Our experience is that this sort of practical demonstration helps to instil real enthusiasm into any student who is worth his salt.

Nicotine and Hops

IN the course of a recent holiday in the Weald of Kent we were struck by the pale and emaciated appearance of a number of the local agricultural workers; and since we ourselves benefited considerably from the salubrity of the air and the excellence of the food available, we were moved to inquire the reason for the apparent lack of health among these rural workers. The information we received was that these men were hop-cultivators and that they were suffering from nicotine poisoning, as a result of using sprays and dusts of that material to combat the hop-louse and other insect pests which attack the bines. Considering the amount of trouble and care that is taken to protect factory workers who have to come in contact with toxic materials, it does not seem unreasonable to suggest that something should be done for these agricultural workers, who in fact are giving their lives and their health for our pleasure. Two lines of thought present themselves: one is that a non-toxic insecticide should be employed instead of the nicotine—and there have been developments enough in that direction lately, in all conscience; another is that some device should be evolved to make possible the application of the nicotine in such a manner that the operators are not affected. In view of the looked-for revival of agriculture in this country, these lines might well be worked on by chemists and chemical engineers. We could then all enjoy our modest half-pints with a clear conscience in the knowledge that they had not been prepared at the cost of the health and strength of the worker in the hop gardens.

War-Time Records

ON a later page of this issue we publish some details of the war-time achievements in chemical engineering of the well-known East Anglian firm of Davey, Paxman & Company. We have already recorded some similar facts concerning I.C.I. These stories are only the first among many, and, as time goes on, it is our intention to make public the fine record of the many concerns in the chemical and chemical engineering industries whose efforts have made so valuable a contribution to victory over Germany. A large number of firms have willingly responded to our invitation to publish their war records, but it must not be forgotten that the war is not yet finished, and that many points of high interest must still remain undisclosed. Still, even with Japan remaining in the field, there is much that can be told, redounding to the credit of the industries concerned. In the case of Davey, Paxman, our editorial task was made easier and pleasanter by reason of an informal reception accorded to representatives of the technical Press, at which Mr. Edward Paxman, managing director of the company, outlined, in a speech of admirable brevity and clarity, the history of his company and its war-time difficulties and achievements. It is manifestly impossible, at this stage of the world's history, for depleted staffs to visit every works in the country; and it is the personal touch which enables a record to be made more vivid and actual for the benefit of the readers of the future.

MRS. SEAN T. O'KELLY, wife of Eire's new President, is well known in the chemical world in Eire as Miss Phyllis Ryan, for many years the country's leading public analyst.

Lac Research

Reports of Progress from India and Britain

THE annual reports of the Indian Lac Cess Committee and the Indian Lac Research Institute for the financial year 1943/44 have just reached us from Ranchi, Bihar. The following is a summary of the work of the chemical section.

During the year under report, work on shellac-formaldehyde-urea moulding powders was mostly confined to a study of the improvements of flow of the powder and the finish and mechanical and thermal resistance of the moulded articles. Incorporation of certain plasticisers or softeners like coal-tar fractions, ester gum, rosin, cashew-shell oil, etc., has been found to improve the flow of the moulding powders, but the resulting moulded articles exhibit a slight degree of softness at the time of ejection from moulds. The latter defect is, however, overcome by addition of hardeners like calcium oxide, magnesium oxide, aluminium chloride, etc., during the process of preparing the powder. Several batches of powders introducing these modifications were prepared, tested and found satisfactory as regards gloss and strength by several moulding factories in India. Lac Products, Ltd., are making and supplying this quality of powder to several of the moulding firms in India.

Cashew-Shell Oil

Particular mention may be made of the improvement in water-resistance by incorporation of small percentages of cashew-shell oil either by condensing it initially with formaldehyde or as such during the process of preparing the moulding composition both by the "wet" and "hot-roller mixing" methods. In a typical case the water absorption of moulded articles has been found to be as low as 0.4-0.5 per cent. in 24 hours as against 1-1.5 per cent. for the control. Further work in this connection is in progress.

Considerable simplification of the manufacturing processes of moulding powders has been effected by introducing the roller mixing system in which the reaction is carried out in an aqueous medium with very low percentages of accelerators and hardeners. This has formed the subject of a patent which has since been accepted. Such roller-mixed powders, when prepared with appropriate fillers, can cater for a wide range of moulded articles where improved gloss is desired. It has, however, been observed that alcohol does play some other important part besides serving as a solvent for the reactions, as roller-mixed powders are definitely weaker, due both to the finer crushing of the filler and the absence of methylated spirit. This has been proved by the introduction of small quantities of higher alcohols like fusel oil, butyl alcohol, cyclohexanol, etc., in the reaction mixture. As a matter of fact, by eliminating ethyl alcohol altogether and using higher aliphatic alcohols as the media for reaction, much superior moulding powders have been prepared both in regard to the strength of the articles moulded from them and resistance to water.

To effect further improvements in the direction of water-resistance, several mixed fillers and waterproofed fillers have been tried during the period under review with a fair degree of success. It has been found that heat-resistance and water-resistance of the moulded articles are considerably improved by baking the articles at gradually increasing temperatures from 80° to 130°C. over a period of 24 hours. Such baked articles, when immersed in water for 24 hours, do not lose their gloss or appearance and are found to resist temperatures up to 120°C. without softening or warping.

Experiments were undertaken to substitute urea and formalin by cheaper and more easily available materials, and although the moulded articles with the altered composition are satisfactory from the point of view of production and finish, the strength of such articles was found to be poor. Further work to improve the strength of the composition is in progress.

Wood Fillers

The influence of the nature of fillers and their particle size on the finish and strength of the moulded articles was further studied. Among the many Indian woods investigated for the purpose of using as fillers, teak (*Tectona grandis*), haldu (*Adina cordifolia*), and sal (*Shorea robusta*) have been found to give satisfactory results as regards both finish and mechanical strength of the moulded article.

Pilot plant trials and manufacturing conditions for the preparation of formalin from methyl alcohol have been completed and the plant is now operating to produce daily 50-60 lb. of formalin of 40-45 per cent. strength.

Varnishes with improved electrical insulating properties and water resistances have been prepared. In the coating compositions developed for making oilcloth, waterproof book-binding cloth, etc., and instantaneous recording discs, some of the defects previously noted have been successfully overcome by changing the modifying agents in the varnish.

Adhesives which stand the action of boiling water for long periods and are suitable for joining glass to glass, glass to metal, and

metal to metal, etc., have also been formulated. The ethyl acetate method of preparing the hard lac resin has been thoroughly investigated and the optimum working conditions worked out. A complete study of the dielectric properties of lac, lac constituents, and their modifications as compared to other natural resins has been made, while an improved method of bleaching lac has been worked out.

A simple method of dewaxing lac with partial bleaching has been attempted, and it has been found that the method could be adopted on a commercial scale for producing light-coloured partially-dewaxed lacs. Incidentally, it may be mentioned that fairly good quantities of wax also could be obtained as a by product.

Dr. Gidvani's Paper

Dr. B. S. Gidvani, who has been pursuing with vigour the work of the London Shellac Research Bureau from its laboratories in Edinburgh, has reprinted his lecture delivered to the Oil and Colour Chemists' Association (Scottish Section) last November. The paper is published in full in *J. Oil and Col. Chem. Assoc.* (1945, 38, 83). The main themes of his address were the chemistry of lac (about which too little is known) and recent developments in the uses of lac due to research.

In the discussion which followed, particular interest was taken in the water-soluble colouring matter, most of which is removed during the conversion of stick lac to seed lac. This water-soluble dye is called laccaic acid, and was first examined by Schmidt in 1887. It is known that it is a hydroxyquinone, but whether it is an anthra-, a benza-, or a naphtha-quinone remains to be settled. Until the advent of coal-tar dyes, this dye was exported from India in considerable quantities. As lakes, a wide range of beautiful colours can be, and were, obtained. But to-day it is an unwanted by-product of the industry and is just thrown away. It is questionable whether this should be allowed to continue, and whether attempts should not be made to reintroduce it, especially as coal-tar is a wasting asset and could be employed for other more important and profitable uses than for the manufacture of dyes.

The water-insoluble dye, erythrolaccin, has also received some attention, but its structure is also not fully known. It is believed to be a tetrahydroxymethyl anthraquinone, but Professor Spoerri could not get an anthracene by zinc-distillation and considers it to be dihydroxymethyl naphthaquinone.

A Neglected Dyestuff

In reply to a question by Mr. J. V. Crossley, Dr. Gidvani explained that the water-soluble dye was exported from India long before shellac came to the forefront. It was only after the trade in this colouring matter had almost died down that the export of the shellac resin assumed its importance. The hydrochloric acid solution of laccaic acid dyes silk and wool directly, giving a brilliant orange-red, and the dyed materials are practically fast to light. Lüdy has recorded that he had exposed them to the August sun of Switzerland for several days on end and could find no signs of fading. For brilliance of colour, laccaic acid rivals the dyestuff obtained from cochineal. Silks dyed with laccaic acid, when immersed in inorganic salt baths, give a whole range of splendid colours; for example, with ammoniacal copper oxide, blue-violet is obtained; with lead acetate, light or dark reddish-violet, depending upon the period of immersion; with potassium dichromate, reddish-yellow; with copper sulphate, violet; with lead acetate and subsequent treatment with aqueous hydrogen sulphide, deep violet; with ferric chloride followed by aqueous hydrogen sulphide, reddish brown; with barium hydroxide, dark carmine-red; with calcium chloride or barium chloride, bright carmine-red; and with copper sulphate followed by hydrogen sulphide, a dark brown shade is produced. Laccaic acid can also be used for dyeing cotton, but it is reported that twenty different imprinted mordants on cotton strips gave somewhat duller shades than those on silk and wool.

In answer to Mr. A. H. Whitaker, Dr. Gidvani said that he would be very glad to obtain a sample of the dye from India and would appreciate it if Mr. Whitaker would undertake a thorough examination of this material.

NEW ELECTRIC RECORDER

A completely revised edition of list 812, which deals with the latest developments of electrical recorders for heat economy and control measurements has been published by MESSRS. ELLIOTT BROTHERS (LONDON), LTD., Century Works, London, S.E.13. A new model, the "S" type, or small recorder, which is smaller and cheaper than the standard "L" types, has been included. It is available as a single-way wall mounting instrument only and has an indicating scale 3½ in. long. The chart, whose useful width is 3¼ in., lasts for about one month at a speed of 1 in. per hour. Approximately 6 hours of record are visible through the glass-fronted door of the instrument. Arrangements can be made for allowing the chart to run out of a slot at the bottom, or to be re-rolled on a spool. The new model is provided with a synchronous electric motor drive for single-phase A.C. supply, but an alternative 8-day spring-driven clockwork mechanism can be fitted.

A Story of Planned Production

Davey, Paxman and Co's. War Achievement

WHILE some towns are self-confessed manufacturing centres and measure their war-time output by the number and complexity of their factories, Colchester is, as far as heavy engineering is concerned, almost a "one man band." Its production is centred round the firm of Davey Paxman & Co., Ltd. In this article, the story of their war effort, which embraced such diversified products as submarine engines, sprockets for final wheel drive in tanks, Radar generators, rotary vacuum filters, smoke-making apparatus, and sea forts' power plant, is told as far as it concerns the chemical industry.

The Standard Ironworks at Colchester are the home of the Davey, Paxman concern which has been in existence since 1865, when Henry Davey, James N. Paxman and Charles M. Davey founded the business under the title of Davey, Paxman & Davey. In 1878, the Messrs. Davey retired from the business, and James Paxman took his son, William Paxman, into partnership and continued trading under the name of Davey, Paxman & Co. In 1898, the company was formed into a limited liability concern, and it became associated in 1920 with Agricultural & General Engineers, Ltd., to be again re-formed as an independent unit in 1932. In 1940 an association was made with Ruston & Hornsby, Ltd., of Lincoln.

For its part in the Battle of Production the company took over a derelict factory, formerly known as the Britannia Works, and reconditioned it for the Ministry of supply in 1941 for the production, under the firm's management, of a Paxman engine. This plant was, however, burned out by incendiary bombs in February, 1944, but in five months it was rebuilt and reopened for production. So great was the war-time demand for Paxman engines that arrangements had to be made not only for the production of component parts in which some 500 firms were engaged but, in addition, the British Renault car factory in London was pressed into service for building Paxman Diesels of which they alone turned out over 650,000 h.p.

While it is for marine oil engines that the company is best known, the following are some outstanding facts about its no less important contribution in the field of chemical engineering. Output included some 25 large filter plants built for chemical factories, collieries, and distilleries. Their main products familiar in war, as in peace, were of help in the war-time operation of the coal industry, and production included flotation machines, mainly used for recovering fine coal or other minerals from 1/12 in. downwards. Separation is effected under vacuum from a mixture of the solids suspended in water, usually about 10 per cent. solids. All flotation plants included the installation of rotary vacuum filters to de-water the clean coal discharged as a froth from the flotation machines. These filters have also been utilised for de-watering

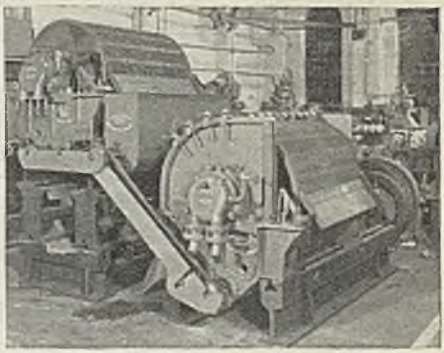

Fig: 1. Two 35-sq. ft. rotary filters.

solids in suspension from paper-mill liquors and effluents, in the recovery of salt from brine and chemical precipitates, and in the recovery of gold cyanide liquors from ore-treatment plants, etc. They may be employed for de-watering clay, chalk, and spent lime liquors, for by-products from the food industry, and for the recovery of anthracene from tar-oil products, for sewage effluent treatment, and for recovering any solids from a liquid suspension that can be satisfactorily filtered (*see* Fig. 1).

Other items in this branch of activity are "U" shaped causticising vessels, varying in length up to about 22 ft., with a horizontal centre shaft on which paddles are fitted; thickener tanks, which were increasingly used in conjunction with Davey, Paxman flotation machines for settling the very fine dirt from the process water which is required for recirculation to the coal washery; and conical clarification tanks used for settling relatively light solids from liquids associated with industrial effluents, such as fibre from asbestos board manufacture and similar materials.

Among miscellaneous apparatus reference should be made to refrigerating machinery, which was ordered through the Ministry of Food for emergency stores, and for War Office barges. Instructions were received to supply numbers of large ammonia compressors for the Lightfoot Refrigeration Co. with whom Davey, Paxman hold a manufac-

going to get cold shivers when they read the following pages; no doubt they will berate me for 'thoroughly unscientific oversimplification.' I shall not mind much. Indeed, I am rather proud how little chemistry there is in this book which deals with all the new synthetic chemical products." It must be recorded, however, that the author has gone to considerable trouble to obtain technical accuracy, and he claims that each chapter has been read by experts in its special field. We should sum up by stating that this is a readable and racy account of the discoveries in synthetic chemistry made during the past 20 years, discoveries which have led to advances in medicine, in industrial products, or in other directions. We would recommend it to those who desire to get a bird's eye view of what has happened in industrial chemistry in recent years, without the mass of chemical formulæ (though some formulæ are not wanting) with which the more scientific writers on the subject naturally obscure the romance of the achievements of the 20th century.

Diatomite in Scotland

Possible Development

SINCE the publication of our note on Mr. R. H. S. Robertson's advocacy of the revival of the diatomite industry in Scotland (THE CHEMICAL AGE, May 26, 1945, p. 456) we have received further information on the subject from a Scottish correspondent. It appears that efforts are now being made to interest Government and industrial circles in the deposits; and what is now visualised, with the backing of competent geologists and civil engineers, is the modernisation of methods and their application to this dormant industry.

As Mr. Robertson has pointed out, the average skeletal content of diatomite is in the region of 40-70 million to the cu. in.; sp. gr. 0.45 or, in dry loose powder, 0.12 to 0.25; it is resistant to chemicals with the exception of hydrofluoric acid and caustic alkalis; has low thermal conductivity and high fire resistance; and is excellent as a filter or as an abrasive.

Among the numerous possible uses, it is perhaps in the sphere of insulation that the Scottish industry is most interested in the mineral. As an insulating covering material for furnaces or ovens it is in considerable demand and is used with a combination of materials including clays, bricks, lime, or asbestos. There is also a strong trend of thought towards its use in the growing plastics industry.

The argument advanced by those now interested in the development of the industry is that prices of imported diatomite—and in a normal year we imported 42,000 tons—have jumped by almost 100 per cent. since the outset of the war. The war-time level will probably not be maintained, but every ton of diatomite imported, at whatever price, means a corresponding loss of employment to the nation, and particularly to isolated areas where such employment would be invaluable. The point then emerges: can these deposits be adequately, efficiently, and economically worked?

The following data will assist towards a decision. Before the war a syndicate was in process of formation to work extensive deposits in Skye. Owing to war complications these negotiations fell down, but the preliminary work is still available. The surveys then made show that in Skye in an area held by a Glasgow firm on lease, there are approximately 1,500,000 tons of diatomite awaiting extraction. It is not pretended that the quality is superior or equal to the best now imported, but it is of moderately good type, regarded as specially suited for industrial insulation.

Method of Extraction

The diatomite is largely located in loch beds or in similar areas and would require to be gained by pumping. The surveys show that the loch beds vary from 6 to 41 ft. in depth and care would have to be exercised in winning the material. It is suggested that the production problems involved are not too complex despite the situation and that barges or pontoons could be used, so as to leave the loch beds undisturbed; pumping operations from these pontoons could transmit the diatomite to drying and grinding plant on the lochside, whence the material could be shipped to Portree or any other convenient pier, for further processing or for transmission to the mainland where milling could be done in a central plant. There is considerable justification for the opinion that the work should be done in the area of actual production so that full benefits might be offered to the natives.

The estimated cost of development of the deposits is given as being between £40,000 and £50,000; and it is urged that the project should be undertaken either by a Government-sponsored concern, or by an independent group. The fact that these deposits are at present lying neglected and awaiting development at a time when imported diatomite has jumped from £30 to £70 for first grade and from £14 to about £27 for insulation grades, suggests the wisdom of further consideration of development along modern lines, as well as of the deposits in Aberdeenshire, Shetland and elsewhere.

The recent application of mechanisation to surface mining suggests that a Government-sponsored or syndically-owned plant could be moved from area to area, as the volume of material justified, thereby reducing the overheads.

Metallurgical Section

Published the first Saturday in the month

Keep your eye on the WATER

Expert advice for water users

Pumping and conveying water to where you want it take a lot of power (and much fuel and money). Water is even more precious if it has been heated or purified in your works.

How to make the best use possible of your water supply is told in these handy booklets:

FUEL ECONOMY BY WATER SAVING (*Bulletin No.* 31)

This is a survey of the economies (many of them substantial) that are possible in water supply for boiler feed, drinking and washing, process and cooling. It tells you, too, how to clean water mains and plant, and how to keep them clean.

WATER TREATMENT (*Bulletin No.* 39)

The correct treatment of water, whether for boiler feed, cooling or process is a matter for the specialist. This Bulletin surveys the whole field and describes briefly the methods available for overcoming your difficulties.

BLOW-DOWN (*Bulletin No.* 35)

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THE UNORTHODOX USE OF ECONOMISERS (*Bulletin No.* 30)

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Metallurgical Section

July 7, 1945

The Past and Future of Steel

Dr. Desch's Inaugural Harold Wright Lecture

IN recognition of the long and outstanding work of their chief metallurgist, Mr. Harold Wright, Dorman, Long & Company, Limited, Middlesbrough, endowed a triennial lecture given under the auspices of the Cleveland Scientific and Technical Institution. The first Harold Wright Lecture was delivered by Dr. Cecil H. Desch, F.R.S., in Middlesbrough, on December 13, 1944. He chose as his subject: "The Past and Future of Steel."

Ancient History

Dwelling briefly on the ancient history of iron and steel, Dr. Desch recalled that iron came much later in history, or rather prehistory, than copper or bronze. The knowledge of the art of smelting iron ores and converting iron into steel gave certain tribes and peoples a great advantage in warfare over those who were still restricted to bronze, and this was a factor which had to be reckoned with in the study of ancient history. It is true that, long before iron was produced by smelting, iron tools and weapons were occasionally made and are found in ancient graves in Egypt and elsewhere, but these are of natural origin, being forged from meteorites—alloys of iron and nickel from outside the solar system. Even in recent times, the Esquimaux of Greenland obtained their knives in this way. The earliest piece of smelted iron (distinguished by containing no nickel) he had examined was a fragment of the blade of a dagger found at Tell-el-Asmar in Mesopotamia, its date being about 2750 B.C. Long after that time iron was still a semi-precious metal, so valuable that a lump of it could be awarded as a coveted prize to the winner of the athletic games recorded by Homer. Lumps of iron ore were picked by hand, heated with charcoal in a small hearth until reduced to a spongy mass of metal, and then hammered between stones until most of the slag or cinder was squeezed out. That primitive process still survives unchanged in some parts of Asia and Africa. It was known that steel, which could be hardened by quenching in water, could be produced by further heating of the iron lump in charcoal, but the product must have been erratic, as we read of the Icelandic poems of heroes, in the midst of a battle, having to pause to straighten their swords under their heels. This state of things was only gradually changed in the course of centuries, and the trade of smith long remained a privileged one, with some degree of mystery attaching to all its operations.

The famous Delhi pillar, a column 24 ft. high and weighing 6½ tons, was made by Indian smiths about A.D. 300, and is now believed to have been built up in a vertical position by welding pancakes of such direct iron one on another, the level of the two furnaces (that for heating a new pancake and that for keeping the top of the column hot) being raised as the work progressed. It was a marvellous achievement, using no crane, forging hammer, or other mechanical device.

As furnaces grew larger and temperatures higher through improvements in blowing, the product changed, at first in a most unwelcome way, into a fused mass, brittle when cold and useless for tools. This cast iron formed the raw material for malleable iron, as it was found that by exposing it to a blast of air when hot the brittleness could be removed, a change which we now explain as being due to the removal of carbon. This indirect process gradually supplanted the older method, and became the basis of our modern combination of the blast furnace and the subsequent processes for conversion into steel, a change which came about in Western Europe in the 14th century.

Eastern Technique

In the East quite a different technique had been developed. At the time of the Crusades, the famous Damascus swords had the reputation of being far superior to anything made in Europe. Damascus was merely the market town through which they reached the Near East and the West, and their actual sources were Persia and Northern India. The swords, apart from their beauty of pattern, were noted for their capacity to take and retain a keen cutting edge. They showed, when etched with some corrosive substance, a characteristic "watered silk" pattern, which we have come to call a "damask" structure. The microscope shows that it is formed by bands of hard material, consisting of clouds of carbide particles, embedded in a softer matrix. The material, a high carbon steel, was melted in a crucible

and allowed to cool very slowly, solidifying in the form of a cake. The steel then had very large dendritic crystals, and the forging was carried out at such a low temperature that the primary structure was not destroyed, although the carbide was broken up into small rounded particles. The skill of the craftsman lay in his so varying the direction of forging, folding over and crumpling the mass, as to compel this primary structure to assume the desired pattern.

There are other methods of production which were famous in their day but have now either sunk into comparative insignificance or have disappeared altogether. Puddling, which revolutionised the manufacture of bar iron when it was introduced by Cort in 1784, by enabling a wider range of ores to be used, lost its supremacy when the Bessemer process was invented, and although the best quality of puddled iron has properties which still make it the safest material for railway couplings, crane hooks, and similar objects subjected to shock and bearing a great responsibility for human life, it only forms a minute fraction of the British production, and has disappeared from several other countries. Its greater margin of safety, as compared with mild steel, is due, not as is sometimes said to the fibrous character of the iron, but to the fibrous arrangement of the enclosed cinder, which causes a fracture, once started, to change its direction repeatedly, so redistributing the stresses and bringing about a slow tearing rupture instead

Dr. C. H. Desch.

of a rapid fracture. This texture also tends to check deep attack by corrosion.

Shear steel, a product which in recent times was peculiar to the Sheffield district, has had a great reputation for the making of all kinds of cutting implements. Made by the very slow carburisation of pure Swedish bar iron in the cementation furnace, followed by forging, doubling, and again forging, the carbon was so distributed as to enable a perfect cutting edge to be maintained. Shear steel was not, and could not be, homogeneous, so that when Benjamin Huntsman in 1740, seeking for a material of uniform texture for making clock springs, conceived the idea of melting the bars from the cementation furnace in a clay crucible, he made an innovation of great importance, without knowing that this had long been an Indian practice.

The crucible furnace came to be used for melting other steels, including those with alloying elements. The metal being contained in the crucible, it is not in contact with fuel or flame and its composition is under very close control. The modern high-frequency type of electric induction furnace with 500 or more alternations a second is more flexible, and from our experience at the National Physical Laboratory with high-frequency vacuum furnaces for experimental work, I am inclined to think that such a refinement of the methods of melting steel may have industrial possibilities.

Bessemer and Open Hearth

The Bessemer process, so far as this country is concerned, rose rapidly into importance, reached its maximum about 1913, and gradually declined, only entering on a new career in the course of the last few years. On the Continent it, of course, occupies a much more prominent position. Looked at scientifically, it is at a disadvantage in comparison with the open hearth in being so rapid that exact control of the refining reactions is difficult. However, Bessemer steel has advantages for certain uses, and the ingenuity of its inventor has had a profound effect on the development of the steel industry, both in Europe and America, and it is well to remember that in its modified basic form it was responsible for the creation of the great Continental industry of cheap steel.

The open-hearth process, now the dominating one in all steel-making countries, is the most flexible of all refining processes, and the one which best lends itself to scientific control. Whether in the acid or in the much more widely used basic form, it furnishes the bulk of the world's steel. There is still room for improvement in furnace design and, in fact, for much research on the best arrangement of ports and chequers, on the characteristics of the most efficient flames, etc.

For special steels, the electric arc furnace is used extensively. The reactions are, in the main, similar to those in the open hearth, but the very different character of the slags gives rise to important differences. There have been many plans for duplex processes, some of which have come into extensive use. The blowing of hot metal in an acid Bessemer converter to remove silicon and carbon, followed by treatment in a basic open-hearth furnace to remove phosphorus and complete the conversion of steel, is one

form, and the use of an electric furnace to finish steel which has been partly made in a Bessemer or open-hearth furnace is another. Only thorough trials, with systematic records of fuel consumption and a statistical analysis of the heat balance and of the quality of the product, can show whether it is worth while to adopt the extra complication of a duplex process in any given circumstances.

Chemical Analysis

We may consider for a little how scientific operations came to be used in controlling the manufacture of iron and steel. Chemical analysis was the first of these scientific helps. The little textbooks which were first published in Germany in the early part of the 16th century show that quantitative methods were in use for the assay of the ores of gold and silver, but not for ores of iron. Agricola, however, in his *De Re Metallica*, published in 1556, mentions a method of valuing iron ores by calcining, concentrating by means of a magnet, and melting under a flux, a simple form of assay which, curiously enough, has become the basis of one industrial process for concentrating poor ores. But the use of chemical analysis in a more exact way only came much later, when Bergmann showed that the differences between pig iron, wrought iron, and steel were due, in the main, to varying proportions of carbon. The methods in use in our laboratories were not developed until the 19th century, and much of the improvement in methods of analysis has taken place since the last war. In this country, the Methods of Analysis Sub-Committee has done, and is doing, much to establish standard methods, so that different laboratories working on the same materials may obtain identical figures. Similar progress is being made in America. The conventional methods of analysis—weighing of precipitates obtained from solutions, volumetric titrations, combustion in a tube with absorption of the volatile product, and so on—still occupy the foremost place, but they have been supplanted by others, such as the spectroscope, which became the spectrograph, adapted to very rapid and accurate estimations, especially in alloy steels.

Microscopic Methods

Next to chemical analysis for the control of the manufacture of steel, and omitting mechanical testing, which is rather the concern of the engineer, we must put the use of the microscope. As far back as 1665, Robert Hooke examined the edge of a razor blade under the microscope and published a faithful drawing of what he saw, but after this, except for a few casual and unimportant observations, we have nothing until we come to Henry Clifton Sorby, a Sheffield amateur, who in 1862 made the first careful microscopical studies of steel, developing the structure by chemical etching. It is fortunate that the first specimens he examined were of cemented steel, with a well-defined coarse structure. Had it happened to have a structure like that of a modern heat-treated alloy steel its interpretation would have been

Mr. Harold Wright.

too difficult, but, as it was, Sorby succeeded in identifying the principal constituents of carbon steels and cast iron, and his identifications are at the root of all our metallographic work. Sorby's discovery was entirely neglected by his contemporaries, and it was only more than 20 years later, when without knowledge of his papers the method was devised by Martens in Germany, but used with far less skill, that attention was drawn to his early studies. With instruments specially designed for the work we can now take photographs showing the most exquisite detail, and the standard of illustration of papers on the structure of steel is high.

Turning to the electron microscope, a wonderful device full of possibilities, Dr. Desch said that electrons, sent out by a heated filament, were focussed, not by transparent lenses, but by circular magnets, which focus the beams as glass focusses light. With such an instrument, magnifications of 20,000 diameters and sometimes even 40,000 could be obtained, showing much finer detail than could be seen by any optical means. What may we expect from such high resolution (mere increase of magnification being useless unless accompanied by increased resolving power)? Well, the beautiful work of Lucas in New York, using light at its furthest limit, had shown that the so-called needles of martensite had a complex internal structure, and no explanation of the hardening of steel could be satisfactory which did not take that structure into account. A great deal of metallurgical work, on hardenability, on intercrystalline failure under corrosion or stress, on creep at high temperatures, on temper brittleness, and on other peculiarities of steels, had shown the importance of conditions at the boundary between different

grains in a solid mass. Rosenhain thought that at those boundaries there was a region of appreciable thickness in which the atoms might be considered as arranged at random, so as to belong to neither of the adjacent grains. Modern work on the attraction between atoms prevents us from taking that view, but at the boundaries there must be a layer, a very few atoms thick, in which the conditions differ from those inside a grain. In that layer, owing to surface tension, impurities may be concentrated, and this will account for the extraordinary influence of very small quantities of certain added elements. Even 0.003 per cent. of boron appears to affect the hardenability of certain alloy steels. Equally distributed through the mass its effect would be negligible, but concentrated in a layer two atoms thick it may act quite differently. We were looking to the electron microscope for help in such difficult problems. Unfortunately, reflection of the beam from the steel was not usually practicable, and the etched surface had to be examined by taking a thin cast in one of the plastics and treating this as a transparent object. Happily, this gave a very perfect reproduction of detail, and the results were remarkably beautiful.

Other physical methods include the very varied applications of magnetic testing, thermal analysis, dilatometry, X-rays, both for the detection of flaws and for the analysis of structure, and electron diffraction. In fact, we have at hand a great variety of physical methods which we may use in the study of steel, and potentiometers, amplifiers and cathode-ray oscillographs are becoming familiar objects in industrial laboratories.

Bell's Experiments

In thinking of the rapid progress of physics we must not forget that the production of steel is essentially a chemical operation. The foundations of the physical chemistry of ironmaking were laid in Middlesbrough by Sir Isaac Lowthian Bell. Impressed by the idea that all carbon monoxide escaping at the mouth of a blast furnace was due to incomplete reduction and represented so much wasted fuel, some ironmasters greatly increased the height of their blast furnaces with the object of producing only carbon dioxide. Bell, by showing that the reduction of iron oxides by carbon was a reversible process, and that to every temperature there corresponded a definite equilibrium, proved the fallacy of the proposal and studied, by a series of brilliant experiments, the nature of those equilibria, calculating the coke consumption which could be obtained under the best possible conditions. His estimates were very near the truth. He had studied chemistry in France under Gay-Lussac, and although his record as an original investigator entitles him to a high place in the history of the industry, he missed the discovery of a simple law relating the reactions to one another. That was reserved for another great chemist, Henry Le Chatelier, who based his work on that of Bell.

The Thomas Process

Sidney Gilchrist Thomas, a remarkable man of high character, whose early death was a grievous loss to science as well as to industry, knew well what he was seeking for in his experiments on the removal of phosphorus from steel. The practical development of his process in the works of Bolckow, Vaughan at Middlesbrough, with the help of Dr. Stead, established its position. It should be noted that it was the Thomas process which gave Germany the industrial leadership of Europe, by making available the easily accessible phosphoric ores which were perfectly suited to the new method of manufacture, the formerly despised 'minette.' Since Thomas, the scientific control of iron and steel making has increasingly replaced the old rule of thumb, and a knowledge of physical chemistry has become essential.

Rust

That iron rusts is one of the most obvious of all its properties. Pliny, in the 1st century, said that rusting was a curse laid upon iron by the gods because of the uses to which it had been put in war. He even has a passage in which he seems, in describing the flying of masses of iron through the air, to anticipate modern artillery and bombing. Without subscribing to his explanation, we have to recognise the fact that in ordinary atmospheres, especially in industrial regions, rusting sets in after a short time in the absence of some means of protection. It may be asked whether there is any prospect of obtaining immunity from rust with some smaller proportion of the expensive alloying elements. After a very long and extensive series of experiments in the field and in the laboratory, it must be answered that there is no evidence of such a possibility. Small additions of copper and chromium increase the life of steel under atmospheric, but not under submerged, conditions, but for structural purposes it remains the fact that the resistance of steel to corrosion depends on the perfection of its coat of paint."

Protection Methods

There remain important possibilities of protecting steel by a superficial layer produced chemically or electrochemically *in situ*. The Russian sheet iron had a thin coating of magnetic oxide which adhered with great tenacity. So did the heavier black layer produced by the Bower-Barff process. The anodic oxidation of aluminium has been the means of enormously enhancing the resistance of that metal and its alloys to

corrosion and analogous treatments of iron and steel have been suggested. The formation of a layer of insoluble phosphates has found many applications, and it may be that other crystalline deposits may be found to have merits. Coating with another metal by dipping or by electro-deposition is a familiar method of protection, and galvanising, tinning, plating with nickel, chromium or cadmium are all well known. Owing to Japan's seizure of the principal source of tin, lacquered steel sheets have often had to take the place of tinplate, but there is no effective substitute for containers for foodstuffs, and when tin is again available it will once more be preferred by the canning industry. In view of the sparse occurrence of ores of tin, it is essential to conserve the metal, and while electrolytic tinning offers one possibility of economy, processes for recovery of the metal after use should receive more attention.

Scrap Surplus Foreseen

At the end of the war there will be an accumulation of scrap without precedent in metallurgical history. In one way or another this scrap will return to use, bringing with it some difficult problems for the steelmaker. There will be a very high proportion of alloy steels from tank armour, guns, aircraft, etc. In so far as those steels find their way to the blast furnace or the open hearth and become diluted with ordinary metal, they will cause an increase in the residual elements which in recent years have given some trouble in meeting certain specifications. Chromium, for instance, tends to pass into the slag and be largely lost. It would seem desirable that some research work should be directed to the recovery of the more valuable alloy constituents.

Another prospect is that of using low-alloy steels in place of mild steels in structural work, with consequent saving in weight. After the last war, the return of ship armour to industry led to an increased use of nickel-chromium-molybdenum steels for engineering purposes, and we may see a more extensive development when the present war ends. One can picture a wide use of low-alloy steels in bridges and framed structures, but it will be necessary to undertake a good deal of experimental work to ensure that the new materials are used to the best advantage. Above all, efforts must be made to economise as far as possible the world's dwindling resources of the rarer metallic ores.

Drain on Natural Resources

This mention of conservation led Dr. Desch to the highly interesting question of the drain on natural resources caused by the growth of modern industry. "It has been pointed out," he said, "that the consumption of the most important raw materials has been increasing in geometrical proportion. The total quantity of minerals raised in the first quarter of the present century was greater than that raised in the previous history of the world, or say 6000 years since copper was first smelted. The quantity doubles itself in a period varying for different materials from 12 to 20 years. Plotting the logarithm of the world's consumption against the time, and allowing for the disturbances caused by wars and slumps, a very fair approximation to a straight line is obtained in many instances. Of course, the relative contributions of different countries or empires vary much more widely, and the simple picture refers only to world figures. Clearly, this cannot continue indefinitely. The curve for coal has shown a falling off, partly on account of the rise of other sources of power, and partly from greater economy in its use. Others will soon show an arrest owing to exhaustion of available ores. The desire to conceal military preparations made the statistics from some countries uncertain before the war, and since 1939 much has been kept secret, but we know that the consumption has been immense. According to the White Paper on the war effort, production of iron and steel has increased only slightly in Great Britain, but we know that in the United States and in Russia the increase has been very great. The proportion of the total production which consists of alloy steels has risen in a remarkable way."

Large Post-War Needs

"That an active demand for steel will continue for at least some years after the war is certain. The replacement of bridges, railways, shipping, industrial plants, and buildings, destroyed throughout Europe, will in itself demand huge quantities of steel. The destruction of so many iron and steel plants on the Continent of Europe means a greatly reduced capacity for production, even without taking into account the permanent curtailment of production by the Axis Powers on which the Allies will probably insist. On the other hand, the United States and Russia, hitherto producing essentially for home consumption, may use some of their increased capacity for export purposes. That being so, British manufacturers will find it essential to use only the most efficient and the most economical means of producing. It is likely that quality will be as important a factor as cheapness in finding markets, as engineers become more and more conscious of the advantages to be gained by using their materials in the most efficient way. Dead weight is reduced by using steels of higher tensile strength, provided that other essential properties are not sacrificed: every improvement in resistance to fatigue or creep makes possible advances in the design of power plant, and so on. It follows that steel-making will increasingly call for

scientific supervision. Much new plant will be required—modernisation of many plants is overdue—and the design and operation of plant must be guided by scientific knowledge. Hence the growing importance of the technical in relation to the commercial control of industry.

Research in the Future

"The setting up of well-equipped research laboratories, until lately almost confined to a few firms making armament and special steels, is becoming more general. Moreover, the response of the industry to the scheme of co-operative research, now to be put on a new footing by the conversion of the very active group of research committees under the Iron and Steel Industrial Research Council into a Research Association has been such that the habit of pooling knowledge in the course of organised investigations has become well established. It may be claimed that there are few industries in which trade secrets play so small a part, or in which the exchange of technical information is so complete, as the steel industry.

"We shall need a larger number of trained men, for whom we must look to our educational institutions. There is much room for improvement in metallurgical education in this country, excellent though a few of the departments are. At the end of the war there will probably be a large influx of young men into the university and technical college departments of metallurgy. For the leaders of research—the aspect which I regard as of supreme importance—it is probable that metallurgy will increasingly become a subject for post-graduate study, following a degree course in chemistry, physics, or engineering. All these disciplines provide a valuable approach to metallurgy and will be needed for the staffing of works and of laboratories. The background of a good general education is essential, and for that reason I strongly deprecate the setting up of any degree so specialised as to exclude subjects not bearing directly on professional needs.

Trained Technicians Wanted

"Besides these leaders we shall always require an adequate supply of men trained in the practical side of metallurgy from the technical schools. One cannot, however, regard evening classes as a completely satisfactory way of meeting that requirement. The importance of the training is so great that the industry would gain by allowing time for classes in working hours during several years. We shall see the further development of fully integrated plants, and processes will be so perfected as to maintain a high and uniform standard of quality. Changes in plant, such as the replacement of pack mills by continuous mills for the rolling of sheets, will lessen the need for strong muscles, but will still call for intelligence, while the growing complexity of methods of control will mean a high proportion of skilled workers."

Dr. Desch concluded by saying that science had been blamed for many of the misfortunes that have come upon the world. "The blame should be placed on the misuse of science for anti-social purposes. Properly used, science has conferred, and is capable of conferring, the greatest benefits on mankind. The aim of our industry should be to provide, as efficiently as possible, products which are essential, not only to the maintenance of existence in industrial countries, but also to the repair of the devastation caused by war and to the building of a better world. With that aim in view, the best technical knowledge and experience must be enlisted in its direction. The metallurgical industries are old, and their traditions and habits may sometimes make advance slower than in the electrical and chemical industries, which have a shorter history, but the scale of operations is so large and the importance to the community so great that even far-reaching changes in plant and processes should be faced with courage. Geographical factors make it impossible for us to regain the position so long held as the greatest producer of steel, but this country has so often led in technical development that we should aim at maintaining that lead through the co-operation of technical and scientific experts, of educational leaders, and of the representatives of management and labour."

In British Guiana geologists are now working on plans to develop the mining industry of the colony. Surveys in the areas adjacent to the Omai mine on the Essequibo River and to the recently-opened gold mine at Aurora on the Cuyuni River were recently carried out, and in the former area the incidence of scheelite was confirmed.

The Nelson Mission which recently returned from Chungking found that there were only three open-hearth steel furnaces in operation and three under construction, with capacities ranging from 10 to 15 tons. Seven Bessemer converters were in operation and perhaps six more were available or were in process of being dismantled. Ten electric furnaces were producing or ready for operations. In 1944, Chinese steel-producing capacity (by all processes) was 43,000 tons yearly, and actual production was a little more than 16,000 tons, equal to 37 per cent. of capacity. Although excellent grades of iron ore and of coal are available, most of these, unfortunately, are in Japanese hands. In Free China, soft coal is exceptionally high in ash. Coal consumption in China per ton of steel produced is about 10 tons, compared with 1.4 tons in the United States.

Cobalt and Rhenium

By-Products from Manganese Electrodeposition

AS an appendix to his article on the Wet Extraction and Deposition of Manganese (*see* THE CHEMICAL AGE, June 2, p. 485), Mr. A. G. Arend contributes the following notes.

A small but important by-product from the electrolysis bath of manganese sulphate is cobalt, since any traces of this metal that there may be appear in the sludge residue. The earlier treatment of the liquor with hydrogen sulphide or manganous sulphide should not precipitate cobalt, but in large-scale practice this is entirely dependent on the bulk of the precipitated sulphides of arsenic, iron, etc. This represents a further feature in favour of the latter reagent, as its action is more limited, and not so liable to bring down the more voluminous precipitate obtained by hydrogen sulphide.

On the one hand, some difficulty was experienced in 1944 in electrodepositing manganese when a certain amount of cobalt was present, while on the other hand, the sludge residue, mainly accumulating around the anode section, offered a small source of revenue.

Rhenium Reclamation

The foregoing process is one of the few possible sources of the rare metal rhenium which competes with tungsten as the metal of highest melting point. Unlike the cobalt, which passes through to the electrolysis bath, the minute proportion of rhenium is more liable to be retained by the sulphide treatment. Should there happen to be a sufficiency to justify reclamation, the precipitate is digested in ammonium sulphide and ammonium hydrate, which removes the arsenic, and after the acidified residue has been fused with sodium peroxide, and the sulphide precipitation repeated, removing the bulk of the iron, rhenium is concentrated. The process has to be repeated to get a workable quantity of the metal, and then the residue is finally heated in oxygen, and the sublimed mass collected in the cooled section is eventually reduced to metallic rhenium under hydrogen. Rhenium was tried as a thermocouple for pyrometers in place of the noble metals but was not very successful; it is, however, likely to be an important catalyst, and it is also used for special electro-plating, for alloys, and for a number of as yet limited but specialised purposes.

These specialised uses are apparently bound up with the fact that, besides possessing an extremely high melting point, rhenium has a high temperature of vaporisation, and thus suits high-temperature fabrication purposes. Rhenium wire made by the precipitation process, which can be drawn at room temperatures, has apparently been tried for similar activities, although its coefficient of electrical resistance with tungsten has so far occupied most attention. The plated metal has been proposed for hydrochloric acid containers. The metal when in loose black powder condition can be heated and compressed to bars and sticks of considerable strength, but which can only be rolled and forced above 800° C. and have been tried for certain tools.

In laboratory research, rhenium, although as the perrhenate ion possessing somewhat similar properties to the permanganate ion, has the advantage of being colourless. It has been used for potassium determinations in place of the familiar platinum reagent, and if, as expected, it will later be obtained more plentifully, may possibly surpass the latter, where it is somewhat extensively used in the routine testing of chromates, bichromates, and other potassium salts.

It will thus be gathered that, apart from the benefits of obtaining electro-deposited manganese, the process described opens up a means of acquiring two important by-products, about which more will no doubt be heard in the near future.

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Metal Statistics

Consumption of Non-Ferrous Metals

THE Ministry of Supply has issued detailed figures of the consumption, during the war years, of the metals within the scope of the Non-Ferrous Metals Control. These are: copper, zinc, lead, tin, nickel, cadmium, antimony, cobalt, and manganese.

During the 5¼ years to March, 1945, the consumption (in virgin metal alone) of copper, zinc, lead, tin, and nickel amounted to 4,861,000 tons, of which copper comprised 2,254,000 tons, zinc 1,227,000 tons, lead 1,148,000 tons, tin 132,000 tons, and nickel 100,000 tons.

In the 3¼ years to March, 1945, cadmium consumption amounted to 1290 long tons, that of antimony to 14,152 long tons, while 3498 long tons of manganese were used. Consumption of cobalt accounted for 2116 long tons.

While it is not possible to give the 1940 and 1941 figures for the metal content of scrap, which was widely used, in the 3¼ years to March, 1945 (except in the case of nickel, where the period is 1¼ years), metal content in scrap totalled 1,770,000 tons, of

which copper accounted for 1,000,000 tons and zinc for 440,000 tons.

Gross output of unalloyed copper products fell from 264,868 long tons in 1942 to 217,055 long tons last year, the corresponding figures for brass and other copper alloys being 795,789 and 571,423 long tons. Zinc used for brass production amounted to 171,379 long tons last year, as compared with 233,000 long tons in 1942. Galvanising absorbed 34,603 against 41,306 long tons, while 18,023 (50,748) long tons went into zinc alloy die-casting.

As regards lead, cable production was the main user with 114,810 long tons in 1942 and 99,235 last year. Nickel's chief use was in alloy steels which accounted for 16,842 long tons in 1942, falling to less than half that amount last year. The use of tin for alloys (white metal, bronze, gunmetal, etc.) amounted to about half of the 28,500 long tons used by all trades last year, while in 1942, 14,100 tons out of a total of 32,300 were used for this purpose.

Consumption of antimony by all trades aggregated 4772 long tons in 1944, compared with 3900 long tons two years ago. Production of fireproof camouflage equipment took 701 long tons last year against nil in 1942, while production of oxides and other compounds remained at 1300 tons.

Out of a total of 1188 long tons of manganese used in 1942, 653 long tons went into light alloys, the corresponding figures for last year being 861 and 546 long tons, respectively. Roughly half the 1944 cobalt consumption of 787 long tons was in the metallic form.

Photography in Steel Research

New Techniques Described

DIRECT record photography in steelworks was illustrated by a number of lantern slides and a colour film of considerable pictorial merit by Mr. S. H. Thorpe, of the Brown-Firth Laboratories, Sheffield, at a meeting of the Association for Scientific Photography held in London on May 24. Mr. Thorpe described the apparatus he used, and the technique followed, for general photography both in the works and in the laboratory under studio conditions. In metallurgical work, micro-photography (including stereography), the copying of ink prints of etched structures, sulphur-printing and the recording of fine surface cracks by "magnetic etching," all necessitate the use of photographic materials. "Magnetic etching" is the term given to the spraying of iron filings suspended in paraffin on to a specimen held between the poles of a magnet; if cracks are present on the surface the iron particles are attracted to them and the resulting pattern can be permanently recorded in a photograph.

Photomicrography was used extensively and a new technique had been evolved for obtaining photomicrographs of much larger areas than is normally possible. This involved making the negative on a "Kodak" Maximum Resolution Plate at a magnification of $\times 7\frac{1}{2}$ and enlarging this as far as necessary—usually about 12 to 25 times. In this way, it was possible to record 1 cm. sq. of specimen at a total magnification of $\times 100$, in the form of an enlargement 1 metre sq.

The lecturer also referred to another new technique—a method of printing radiograph negatives containing great variations in density owing to variations in thickness of the original specimen. A positive mask was used, which was held slightly out of contact with the radiograph during printing. This produced a general masking of the radiograph, reducing its over-all contrast, but not interfering with the detail in any area. In this way a print could be made which showed defects equally clearly in the lightest and the densest portions of the original.

Dealing with the uses of recording materials in oscillography, Mr. Thorpe described a special camera which incorporated a density-wedge to control the intensity of the light reaching the film in proportion to its speed, in vibration records of decaying amplitude. Mr. Thorpe also dealt with the uses of colour photography and showed some lantern slides of the change of colour in white-hot metal as it cooled, and photomicrographs of refractory materials and of metal specimens.

SIR JOHN DUNCANSON has been released Steel in the Ministry of Supply, and is succeeded by MR. C. R. WHEELER, who has served as deputy-controller since 1942. Sir John, who is a director of the Steel Company of Scotland, worked out an iron and steel distribution scheme which was the basis of the armaments programme. Mr. Wheeler is a director of Guest, Keen, Baldwins.

General News——From Week to Week

More than 200 million filter pads for gas-masks have been produced and tested since 1936 by the Cape Asbestos Co.

Aerolite Foam Glue is the subject of Bulletin No. 31, published by Aero Research Ltd., Duxford, Cambridge.

The estate of Dr. Henry Dreyfus, late chairman and managing director of British Celanese, amounted to £2,499,492.

The Ministry of Supply has given three months' notice to Australian companies of the termination of contracts entered into at the outbreak of war for the purchase of zinc and lead supplies.

A large proportion of the antimony metal, as well as compounds used as flameproofing agents, were supplied during the war by Goodlass Wall and Lead Industries, who also contributed special alloys to the "Pluto" pipe line.

The Board of Trade announces that quotas of lead oxides for the period July 1 to December 31, 1945, for export to Latin America, Portugal, Sweden, Switzerland and Turkey have now been arranged and exporters who desire to participate in these quotas should apply by letter to the Export Licensing Department not later than August 31.

The chairman of The Fullers' Earth Union, Ltd., Mr. J. S. Highfield, announced at the recent annual meeting that the company's plans include not only the resumption of export trade, but also improvements in plant, in operation, and in quarrying methods. An improved form of activated earth is to be introduced as soon as it is possible to complete means for its production.

The discovery of penicillin at St. Mary's Hospital is being re-enacted by Sir Alex. Fleming in a film on Penicillin, sponsored jointly by I.C.I. and the Therapeutic Research Corporation. A series of shots shows the contribution made by Sir Howard Florey, Dr. Chain and their co-operators. Whole battle-front scenes from Holland illustrate the application of the life-saving drug.

Monsanto Chemicals, Limited, advise us that their sales department will again be operating from their London office at Victoria Station House, Victoria Street, S.W.1, from July 9; orders and communications to this department should be addressed accordingly. For over five years war conditions have compelled Monsanto to centralise their organisation at Ruabon, and it is hoped that with the return to London of those members of the staff who have for many years had the pleasure of close personal contact with their friends in the trade, opportunities will be afforded for an early re-establishment of those associations.

From July 1, the registered office of the Research Association of British Paint, Colour and Varnish Manufacturers will be Paint Research Station, Waldegrave Road, Teddington, Middlesex. (Tel.: Molesey 1063-2202.)

The Ministry of Supply announces some easing of the licensing procedure with regard to copper, nickel and zinc. In the case of Service and home civil orders it is no longer necessary to submit schedules of orders to cover applications for licences for these metals. Instead, each application must be accompanied by the following signed statement: "We certify that the quantity requested on the accompanying application is needed to cover orders for our products, and that in the case of applications for virgin metal full allowance has been made for our expected intake of scrap." There is no change in the existing procedure for export orders. Inquiries to: The Joint Controllers, Non-Ferrous Metals Control, Grand Hotel, Rugby.

Foreign News

A recent report from Ceará, Brazil, states that several hundred tons of carnauba have recently been bought by the United Kingdom.

A new chemical research laboratory will be erected by the General Electric Company at Schenectady at a cost of $8,000,000.

The Metal Powder Association has been established in New York, representing 21 producers of metal powders.

In Albania, a cement factory has begun to work. Output will aggregate about 60 tons daily.

The Vitkovice metal works in Czechoslovakia have recently resumed operations giving employment to about 45,000 persons.

Reports from Poland state that the salt mine and plant at Wielicka (near Cracow) is again working normally.

Discoveries for improving the soil, which have been developed by Soviet experts, will be made use of by this country.

Russian manganese ore is being shipped to the United States in part payment for material sent during the war.

The Canadian Department of Munitions and Supply has removed all restrictions on the use and distribution of Canadian zinc oxide and zinc dust.

Freon output in the United States totals now nearly 60,000,000 lb., due to increased production in the Deepwater, N.J. factory of Du Pont's affiliate, Kinetic Chemicals. Last year, a new plant was erected at East Chicago, Ind.

The first trains bound for England with iron ore left the Swedish mines at Kiruna on Monday for Narvik, but in the near future only a limited traffic is expected.

The Kvarntorp shale-oil plants of the Svenska Skifferolje A.B., controlled by the Swedish Government, are soon to be enlarged at a cost of about 8 million kronor. Production will be extended to other products.

In order to assist French inventors, and to promote research activities, the Committee of Inventions and Industrial Property (Comité Supérieur des Inventions et de la Propriété Industrielle) has been formed in Paris

In Colombia, a company has been formed with an initial capital of 4,200,000 pesos for the manufacture of agricultural fertilisers. The capital has been subscribed by the Institute for Industrial Development, the Caja de Crédito Agrario and the Ministry of National Economy.

An oil-rehabilitation team landed with Allied invasion forces on Tarakan (Netherlands Borneo), bringing with it all the equipment necessary to facilitate the resumption of oil production. The most important oil fields on Tarakan are Pamusian in the centre and Djuta in the north.

The recent appointment by the President of Colombia, of a Minister in charge of a new Ministry of Mines and Petroleum (Ministro de Minas y Petróleos), constituted a development of considerable importance for the oil industry. The new Minister has stated his intention to exert every effort to obtain the passage, by Congress, of a new petroleum law.

Totaquina manufactured in Tanganyika in 1944 showed a 20-fold increase compared with 1942, in which year production began in a plant at Dar-es-Salaam. The manufacturing process is relatively simple, and is carried out with plant made or acquired locally. The dried chinchona bark is powdered, treated with lime water, and extracted with gas-oil in the presence of caustic soda. The alkaloids are extracted from the solution by agitation with dilute acid, and the solution filtered. The alkaloids are then precipitated by an alkali, filtered and dried.

After a protracted trial, E. I. du Pont de Nemours & Co., Wilmington, Del., Röhm & Haas Co., Philadelphia, and six officers of these corporations were acquitted by a jury in the federal court of Newark, N.J., on the charge of alleged international conspiracy to monopolise the production of acrylic plastics, mainly used in aircraft manufacture. I.C.I., Ltd., I. G. Farbenindustrie, and Röhm & Haas Co., of Darmstadt, were charged as co-conspirators, but they were not made defendants. This was the first criminal prosecution under the Sherman Anti-Trust Act.

Reports from Ceylon state that investigations into the preservation and concentration of locally-manufactured shark-liver oil are being conducted by the Department of Commerce and Industry. A pilot factory was set up in September, 1944, and since then some 1255 gallons have been supplied to hospitals in the island. About twenty centres have been established for the extraction of the crude oil and the department now proposes to equip more centres with extracting apparatus.

Preliminary production values for Canada's chemical and allied industries last year indicate a decline of about six per cent. from the record output of 1943, the Dominion Bureau of Statistics reports. This was due to lower schedules for ammunition and propellants in the early months of the year. The figure for 1944 has been placed at $719,900,000, more than four times the best pre-war total of $159,500,000, established in 1939. If the shell-filling and small arms ammunition industries were excluded, the value for 1944 would be $364,000,900, compared with $359,000,000 in 1943, and $348,000,000 in 1942. Exports in 1944 totalled $100,700,000, an increase of 16.5 per cent. over the 1943 figures. Explosives, fertilisers, ethyl alcohol, cyanamide, sodium compounds, acetic acid and vinyl resins were the more important items shipped. Of the total, 47 per cent. went to the United States, and 24 per cent. to the United Kingdom.

Forthcoming Events

July 11 and 12. The Iron and Steel Institute. Annual general meeting. The Institution of Civil Engineers, Great George Street, London, S.W.1, July 11. 10.30 a.m.-12.45 p.m.: Official business; presentation of the Bessemer Gold Medal to Mr. Harold Wright; and presentation of the Williams Prize to Mr. G. D. Elliot. Mr. R. Jackson: "The Application of Radiography to the Improvement of Foundry Technique"; First Report of the Foundry Practice Sub-Committee, 2.30 p.m.-5.30 p.m. Messrs. L. Northcott and D. McLean: "The Influence of Centrifugal Casting upon the Structure and Properties of Steel"; Mr. C. S. Graham: "Examination of two Ingots of Free-Cutting Steel, one containing Lead and the other Lead-free"; Mr. T. H. Schofield: "The Microscopical Examination of Samples of Lead-bearing and Lead-free Steels and Ingot Irons"; Messrs. W. E. Bargett and R. E. Lismer: "Mode of Occurrence of Lead in Lead-Bearing Steels and the Mechanism of the Exudation Test." July 12, 9.45-12 noon: Messrs. J. R. Rait and H. J. Goldschmidt: "The Constitution of Basic Steel Furnace Slags"; Mr. Y. K. Zea: "The Phosphorus Reaction in Basic Open-Hearth Practice"; and Mr. A. H. Jay: "A Study

of the Basic Open-Hearth Process, with Particular Reference to Slag Constitution." 1.0 p.m. for 1.15 p.m. Luncheon at the Connaught Rooms, Great Queen Street, London, W.C.2.

July 12. Royal Society, Burlington House, London, W.1, 4.30 p.m. (tea from 3.45). Dr. W. T. Astbury, F.R.S.: "The Structure of Biological Fibres and the Problem of Muscle" (Croonian Lecture).

July 12 and 13. Society of Chemical Industry. Annual general meeting. July 12. Chemical Society's Rooms, Burlington House, Piccadilly, London, W.1. 10.30 a.m., Meeting of chairmen and hon. secretaries of sections and groups; 2.15 p.m., Meeting of council. July 13: The Royal Institution, Albemarle Street, London, W.1. 10.30 a.m. Business meeting; 11.30 a.m., President's address; 12.30 p.m., Lunch at the Savoy Hotel; 3 p.m., Presentation of the Society's Medal to Viscount Leverhulme and Medallist's address; 4 p.m., Tea in the Long Library.

July 17. Chemical Engineering Group (S.C.I.). Tallow Chandlers' Hall, Dowgate Hill, Cannon Street, E.C.4. Banquet for the Ladies: 12.45 p.m. Reception by Mr. and Mrs. M. B. Donald; 1.15 p.m. Luncheon; 4 p.m. Tea. Accommodation limited to 40 couples; price 35s. per head, including apéritifs, luncheon with wines, entertainment and tea.

July 18. Royal Institute of Chemistry (Birmingham and Midlands Section). English Theatre, The University, Edmund Street, Birmingham, 6.30 p.m. Dr. Dorothy Jordan-Lloyd: "Protein Fibres."

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for errors that may occur.

County Court Judgments

FREERS CHEMICAL WORKS, LTD., 130 London Street, Reading, manufacturing chemists. (C.C., 7/7/45.) £15 19s. 4d. May 16.

Company News

Durand and Huguenin A.G., Basle, have declared a dividend of 5 per cent. (same).

Stockholms Superfosfatfabriks A.B. reports a net profit, for 1944, of Kr. 1,880,000 (Kr. 1,810,000). The dividend is 8 per cent. (same).

Eucryl, Ltd., is paying a dividend of 5 per cent. (same) on the deferred ordinary for the half-year to June 30; also a bonus of 7.15d. a share.

Vitamins, Ltd., reports a net profit, for the year to March 31, of £31,077 (£30,933). A dividend of 25 per cent. (same) has been declared.

Anglo-Egyptian Oil Fields, Ltd., announce that last year's profit is £142,819 (£137,820). A dividend of 12½ per cent. (same) is being paid on the "B" shares.

Evans, Sons, Lescher and Webb, Ltd., report a net profit, for 1944, of £22,917 (£18,061). An ordinary dividend of 8 per cent. (5 per cent.) has been declared.

Goodlass Wall and Lead Industries, Ltd., report a trading profit, for 1944, of £572,430 (£389,294). Net profit totals £222,635 (£171,621). An ordinary dividend of 9 per cent. (7 per cent.) has been declared.

The Chloride Electrical Storage Co., Ltd., reports a net profit, for the year to March 31, of £301,033 (£267,072). The ordinary dividend and bonus are maintained at 15 per cent.

Cooper McDougall and Robertson, Ltd., report a net profit, for 1944, of £106,833 (£90,550 for 15 months to December 31, 1943). A first and final ordinary dividend of 5 per cent. (same) has been declared.

British Glues and Chemicals, Ltd., announce that net profits for the year ended April 30, after E.P.T., but before income-tax, amounted to £101,724 (£98,702). The ordinary dividend is again 10 per cent.

Davey, Paxman & Co., Ltd., report a trading profit, for last year, of £71,035 (£64,755). Net profit totals £59,235 (£54,114). A dividend of 15 per cent. (7½ per cent.) has been declared.

Johnson, Matthey & Co., Ltd., report a profit for the year to March 31, of £560,066 (£536,656). A final dividend of 3 per cent. (same) and a cash bonus of 6 per cent. (4 per cent.) make a total distribution of 12 per cent. (10 per cent.).

Unilever N.V. has made the following net profits during the war (in florins): 1939, 31,755,204; 1940, 17,056,267; 1941, 3,725,809; 1942, 1,500,420; 1943, 2,577,618. The 5 per cent., 6 per cent., and 7 per cent. preference dividends were reduced by one-fifth in 1941, while no ordinary dividend has been paid since 1940.

Chemical and Allied Stocks and Shares

STOCK markets have been in confident mood on hopes as to the outcome of the Election. Industrial shares recorded an upward trend and British Funds strengthened, the latter reflecting reinvestment demand arising from this week's big interest and other disbursements.

Imperial Chemical participated in the rise in leading industrials and were 40s. 1½d., while Dunlop Rubber jumped to 51s. 6d., Courtaulds to 56s. 10½d., and United Molasses to 45s. 6d. Lever & Unilever at 49s. 3d., however, lost part of an earlier rise, and Lever N.V. eased to 49s. Iron and steels

were in better demand: awaiting the financial results, Consett Iron 6s. 8d. units rose to 9s., and Guest Keen to 38s. 9d. Tube Investments strengthened to £5½, and Dorman Long to 28s., but Allied Ironfounders eased to 50s. 6d. on past year's figures. In other directions, Borax Consolidated deferred rose to 42s. 6d., while British Aluminium became firmer at 42s. 3d., and British Oxygen at 88s. 6d. were again higher on balance. De La Rue rose to £10¾ after an earlier decline. Among shares of other companies connected with plastics, British Industrial Plastics 2s. shares were 7s., and Erinoid 5s. ordinary 11s. 9d. There was renewed buying of textile shares, particularly Bradford Dyers, which rose to 25s. 3d., Bleachers to 14s. 3d., and Calico Printers to 19s. 3d. Buying was attributed to post-war export trade hopes.

In other directions, Metal Box shares strengthened to 92s., and Barry & Staines were favoured on scope for increasing dividends over the next few years, and rose to 53s. 6d. Nairn & Greenwich were 77s. 6d., and Wall Paper Manufacturers deferred 43s. 6d. British Plaster Board eased slightly to 37s. 3d. in front of the dividend announcement. Associated Cement were 58s. 9d., and Crittall Manufacturing were firm at 28s. 6d. Electric equipment shares have been favoured, particularly Siemens, which advanced to 38s. 6d., while Johnson & Phillips were 77s., General Electric 97s. 6d., and Crompton Parkinson 33s. 6d. Reckitt & Sons ordinary remained firm at 115s. at which the yield is slightly less than 3½ per cent. on the basis of the 22½ per cent. dividend which has ruled for some years; the group deals very conservatively with its profits, and largely as a result of this there is a particularly strong position. Combined sales of the group recorded a further increase last year despite war conditions, and demand for most of the products, it is stated, continues greater than the supply.

Earlier gains were not fully held, but Amalgamated Metal were 20s., Imperial Smelting 15s. 3d., and Metal Traders 25s. 6d. Lewis Berger showed firmness at 118s., and paint shares generally have been well maintained, with Pinchin Johnson 39s. 3d., and International Paint 118s. 9d. Triplex Glass moved up with shares of motor-car manufacturers, and these 10s. units were 45s. General expectations are that the Triplex dividend for the financial year ended last month will be unchanged at 15 per cent., but that as time proceeds there may be scope for considerably higher payments. Pressed Steel shares strengthened to 33s. 6d., Radiations to 58s. 6d., Turner & Newall to 82s. 6d., and the units of the Distillers Co. to 116s. Boots Drug firmed up to 56s., and Timothy Whites showed steadiness at 41s. 6d., while Beechams deferred were 19s. 10½d., and Sangers 30s. 3d. B. Laporte remained firm at 87s. 6d., and British Drug Houses continued to change hands around 37s. 6d. Monsanto Chemicals 5½ per cent. preference were 23s., and Greeff-Chemicals 5s. ordinary 9s. 6d. Blythe Colour 4s. ordinary were maintained at 20s. and firmly held on the possibility that payment of an interim dividend may be resumed. Oil shares eased, but Trinidad Centrals rose to 20s. on the higher payment.

British Chemical Prices

Market Reports

A MODERATE volume of inquiry has been dealt with during the past few days on the London general chemical market and the movement into consumption has been satisfactory, with consumers taking steady deliveries. A moderate amount of export inquiry has also been reported and the price position throughout the market remains firm. In the soda products section the demand for caustic soda has been on steady lines, while there has been no quotable change in the position of chlorate of soda. The hyposulphites of soda are steady, and a steady trade is passing in Glauber salt and salt cake. Among the potash chemicals, British makers of permanganate of potash are well booked and supplies of the pharmaceutical and technical qualities are being promptly disposed of. Inquiries for acid phosphate of potash have been on steady lines. In the acid section supplies of oxalic acid remain scarce, while the movement of sulphuric acid into consumption continues active. A moderate call for supplies of hydrochloric acid is being met by producers. There is little change to report from the coal-tar products section, where steady trading conditions operate.

MANCHESTER.—Quotations have been steady to firm pretty well throughout the whole range of heavy chemical products on the Manchester market during the past week. "Wakes" stoppages in various centres have affected somewhat the pressure for deliveries of bleaching, dyeing and finishing chemicals, also certain other lines, but otherwise trading conditions generally can be described as reasonably satisfactory. A certain amount of new shipping business is under discussion. Trade in the general run of fertilisers is at a seasonally low level and may be expected to remain relatively quiet during the next month or so. Although fresh buying in tar products here has only been moderate on the whole, most of the leading light and heavy materials are being taken up steadily under contracts.

GLASGOW.—In the Scottish heavy chemical trade business has shown an improvement during the past week. Prices remain firm. There is no change in the export position.

SERVICING

GRINDING, Drying, Screening and Grading of materials undertaken for the trade. Also Suppliers of Ground Silica and Fillers, etc. JAMES KENT LTD., Millers, Fenton, Staffordshire. Telegrams: Kenmil, Stoke-on-Trent. Telephone: 4253 and 4254, Stoke-on-Trent (2 lines).

GRINDING of every description of chemical and other materials for the trade with improved mills.—THOS. HILL-JONES, LTD., "Invicta" Mills, Bow Common Lane, London, E. Telegrams: "Hill-Jones, Bochurch, London." Telephone: 3285 East

The fact that goods made of raw materials in short supply owing to war conditions are advertised in this paper should not be taken as an indication that they are necessarily available for export.

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