

fare, etc., make it appear as if Science rules. That cannot be helped.

The great religions of the world have all emphasised that the present existence on earth is to be viewed and lived as a preparation for the next, with faith in the grace of God and with realisation of the truth that one's fellowmen are likewise pilgrims proceeding along the Pathway to Reality.

*Mind-Control* is the sovereign remedy for practically all the ills that assail civilised nations and communities to-day. *If Theosophy grew scientific, and if Science grew theosophical, neither would do any good to mankind.* Each should pursue its own way and enrich the resources, material and spiritual, of mankind.

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### British Chemical Industry.\*

SIR GILBERT MORGAN and DR. D. D. PRATT have written a most remarkable book. On a screen astonishingly small in relation to the vastness of the subject, they have thrown a moving picture of British chemical industry that rivets attention from cover to cover (dyed with Monastral fast green GS), being historical, modern and vivid. Especially in this country, where an aptitude for chemical industry has been slow to reveal itself, the new treatise will be valued as a foundation for practice and a stimulus to development. In a most attractive literary form, it provides the advanced student with concise but ample information; and should be consulted also by those members of the cultivated public who desire to be cognisant of industrial progress.

The authors have adopted an agreeable arrangement of the chemical arts by grouping them under the naturally occurring raw materials on which they depend. Thus the opening chapter, "Salt", describes alkali manufacture and industrially important chlorine compounds such as bleaching powder and aluminium chloride, while "Sulphur" covers the various forms of sulphuric acid and the related salts of the oxyacids. "Sand, Clay and Limestone" is the chapter-head introducing glass, lime, cement and ceramics, followed by "Industrial Gases" embracing air-liquefaction, the rare gases, synthetic ammonia, nitric acid, carbon dioxide and acetylene. Then follow "Selected Metallurgical Processes" to include nickel, precious metals, sodium, aluminium and magnesium; "Borax and Phosphate" dealing with the manufacture of some new abrasives, phosphorus and

superphosphate; "Paints and Pigments" describing the whole range of industrial whites, metal-colours, lakes and monastrals, concluding with sections on the ingredients and manufacture of paints. "Oils, Fats and Waxes" is the caption for vegetable, animal and marine esters, their extraction, refining and hydrogenation, with attention to margarine, soap and glycerine; while "Cellulose" deals with paper and rayon. "Coal" presents the gas, coke and tar industries, low temperature carbonisation and coal-hydrogenation; the remaining chapters comprising petroleum, explosives, dyestuffs with intermediates, plastics with rubber, industrial solvents and fine chemicals, the last-named including anæsthetics, hormones and vitamins.

Along with clarity of exposition, a welcome feature is the skill with which modern practice has been shown to proceed from the more venerable methods. Thus an outstanding impression in the mind of a reader will be the revival, almost a renaissance, noticeable in this industry since the War. On an early page the authors replace the old saying that "there was no better barometer to show the state of an industrial nation than the figure representing the consumption of sulphuric acid per head of population," by the more pertinent dictum "there is no finality in chemical industry". Abundant illustrations of this principle are given, among which the following may be mentioned. Until the beginning of the century industrial oxygen was made by Brin's process, now entirely superseded by air-liquefaction and fractionation, leading to scores of millions of cubic feet being used annually for metal-cutting and acetylene-welding, while commercial uses have been found for the by-products, argon, neon, helium, krypton and xenon. The refining

\* *British Chemical Industry ; Its Rise and Development.* By Sir Gilbert Thomas Morgan and Dr. David Doig Pratt. (Edward Arnold & Co., London), 1938. Pp. xii + 387; plates 32; figures 79; tables 34. Price 21s.



of nickel by the Mond (carbonyl) process, one of the outstanding chemical engineering achievements of recent years, now deals with huge deposits of ore derived from Ontario, yielding concentrates rich in platinum and palladium, with minor quantities of rhodium, ruthenium, iridium and gold. Particularly engaging to Indian readers will be the section on aluminium, not only because, arising from the enterprise of Sir Alfred Chatterton, use of aluminium household vessels is widespread, but also for the much canvassed possibility of manufacturing the metal in this country, which possesses the necessary bauxite. Its high electrical conductivity has lately brought aluminium into rivalry with copper as a current-carrier on a very large scale indeed, and its property of yielding an extensive range of alloys with copper, chromium, manganese, nickel, silicon and zinc has greatly augmented the demand in recent years. Even more dramatic has been the commercial emergence of magnesium, now used increasingly in making light alloys required for aircraft, of which magnalium (Mg : Al = 1 : 9) is an example; within twenty years the price per pound has fallen from 25s. to 1s. 3d.

The history of rayon is a wonderful record of perseverance and ingenuity resulting in a new and beautiful fibre being added to the resources of textile manufacturers. In 1891 the Chardonnet process yielded 30,000 pounds of artificial silk through nitrocellulose, and in the following year Cross and Bevan discovered the cellulose xanthate reaction; although application was greatly delayed by technical difficulties, these were finally overcome by Courtaulds, Ltd., on whose patience and skill the vast rayon industry of the world is founded. The 1,000,000,000 pounds manufactured in 1935 comprised viscose yarn (76%), viscose staple fibre (10%) and cellulose acetate yarn (12%), with minor quantities of cuprammonium and nitro-yarns. This imposing production equalled one-third of the total wool-consumption and ten times that of natural silk; the price per pound had fallen to 2s. 6d. from 12s. 6d. in 1925. Incidentally, rayon has presented the dye-chemist with new problems, and has had a share in the recent rapid growth of the lacquer-industry while creating a fresh demand for caustic soda, carbon disulphide and acetic acid.

Among so much material of absorbing interest many readers will turn eagerly to the chapter on dyestuffs and intermediates, and will there find a 30-page review of the old, old story which nobody is better qualified to tell than Sir Gilbert Morgan. Some will remember pleasurefully his Hofmann Memorial Lecture (1936) but the present survey is even more vivid, and has the advantage of crowning the early history with a lucid account of quite recent discoveries. No branch of scientific endeavour stages a richer pageant, or one more dramatic in its interplay of success and failure. There pass before us in rapid succession the pioneers, Mansfield, Perkin, Nicholson, Read Holliday, Dan Dawson, Greville Williams and Ivan Levinstein. Then comes the decline of 1865-79 when the Anglo-Germans, Hofmann, Caro, Martius and O. N. Witt returned to the fatherland, recalling the departure of the Roman legions; while Nicholson, Perkin and Greville Williams retired from the struggle. There follows the fall, with increasing predominance of the Rhine, lasting until the War of 1914-18. Thereafter the renaissance, effected by the British Dyestuffs Corporation and Sir James Morton, later fortified by the Dyestuffs Group of Imperial Chemical Industries. Table XXX (p. 293) shows 4,000 tons of British dyestuffs to have been manufactured in 1913 (with no vat-colours), and a 1935 output of 26,000 tons including over 4,000 tons of indigo and other vat-colours. Conspicuous among the latter is Caledon jade green, whose romantic history is here narrated as a preface to the Soledons and Ionamines, to be followed by the Duranols and Carbolans, dispersed dyes for acetate rayon.

It might have been expected that the three succeeding chapters would seem an anticlimax, but this is not so, for they deal respectively with plastics and rubber, industrial solvents, and fine chemicals, all of which branches offer surprising novelties of industrial practice. The first describes resins of the bakelite group, then plastics made by combining formaldehyde with casein and with urea (for non-crease Tootal fabrics), the glyptal resins (paralacs) arising from polybasic acids and polyhydric alcohols, and finally the polymerisation resins, exemplified by perspex, the organic glass obtained from methyl methacrylate. In



1923 the British output of phenol formaldehyde resin approached 500 tons, rising to 15,000 tons in 1936. This remarkable growth has greatly stimulated the manufacture of organic solvents, these being required for applying the resins in the form of lacquer. Not only has the range of solvents been vastly widened, but the quantity in which some are produced has been greatly increased, the most spectacular advance being the synthetic manufacture of methanol. Formerly a by-product of wood distillation, methyl alcohol is now made by catalysis of mixed hydrogen and carbon monoxide, the world-production exceeding 200,000 tons annually.

The very high standard of this work is fully maintained in the final chapter dealing with fine chemicals, among which are mentioned the many new organic reagents for metals depending on the formation of co-ordination compounds; and the spot-tests for phosphorus, tryptophan and the ergot alkaloids. Disinfectants (including the lime-lit prontosil), antiseptics (with dettol), fungicides and insecticides receive due notice, while the pharmaceutical products include anæsthetics, soporifics, antipyretics, arsenicals, sucramine (the ammonium derivative of saccharin, which it excels in sweetness), hormones and vitamins. The section on insulin outlines the manufacture, and relates that the price of this hormone has fallen from 25s. to 1s. per 100 units of a purity-degree so high that one part will remove 40,000 parts of glucose from the blood stream. Under vitamins will be found a description of the four whose chemical constitution has been elucidated, three of which are now manufactured and sold as adjuvants; here is a noteworthy case of highly refined investigations, conducted in more than one branch of science, being rapidly brought to the service of mankind by enterprising industrialists.

It will now have become evident that this latest work of Sir Gilbert Morgan with Dr. Pratt has quite exceptional interest and value. Table XXXIII (p. 367) shows that the British chemical industry employs over 660,000 persons, and exceeds

£400,000,000 in gross output value; but the vital doctrine herein conveyed is the necessity of scientific vigilance and ceaseless research in maintaining this huge superstructure. From that standpoint the book should be read not only by every advanced student and teacher of chemistry, but by all those of non-scientific habit who aspire to guiding public opinion, or to taking part in the government of this country. Here, as in England, there is a tendency not merely to ignore science, but to mistrust it; and even worse, to saddle it with the horrors of modern warfare, disregarding of the fact that these horrors are perpetrated by agents not having the most elementary claim to be classed as men of science. So distorted is the public view of this matter, even among people of cultivated intelligence, that an eminent ecclesiastic recently called for a halt in scientific discovery and invention. In the same confusion of mind an English writer of some (literary) reputation smugly announced, with incredible deficiency of humour, that he had sold his holding (£80) in Imperial Chemical Industries, Ltd., on finding that they manufactured explosives. He did not realise that this is merely one of their countless interests, and that in peacetime these products are manufactured for peaceful purposes alone. It would be more reasonable to refrain from investing in Funding Loan on the ground that the British Government manufactures its explosives solely for war, or preparation for war: or from buying shares in a company making weed-killer, because this is known to have been used for removing inconvenient wives.

If such blind leaders of the blind took the trouble to inform themselves by reading the treatise of Sir Gilbert and his colleague, they would be compelled to recognise that only a minute fraction of the chemical industry is concerned with war-material, and that even this would remain in the harmless category of scientific curiosities or engineering requirements but for the hateful action of non-scientific peace-breakers.

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