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The Dyestuffs Industry and its Lessons

THE story of the dyestuffs industry has often been told, at least in part. Few accounts have been more vivid than that given by Mr. C. J. T. Cronshaw, managing director of the Dyestuffs Group, Imperial Chemical Industries, Ltd., in his Jubilee Memorial Lecture of the Society of Chemical Industry. No such glimpse of the industry from inside has been vouchsafed us since Mr. James Morton gave us the story of Caledon Jade Green and later of Caledon Brown. Mr. Cronshaw's lecture, however, was far more than mere recapitulation. He succeeded not merely in revealing some of the difficulties and problems which the industry presents to those engaged in it, but also its ever-changing aspects and its intricate and intimate relations with other industries.

It would be difficult to find an industry more essentially dynamic than that of dyestuffs. Its very success in ousting the natural colouring matters proved but the prelude to adventure. The wider range of shades, the greater brilliance and enhanced fastness of the synthetic colours led to more and more searching demands. Not merely textiles but almost every other material in common use has come to the industry with its demands for colour, and the newer industries, like the rayon industry have often made but halting progress until those demands were met. Despite its vicissitudes, despite the long struggle for mere existence, the British industry has an honourable share of the outstanding advances to its credit, and those in the post-War period are not unworthy of comparison with the discoveries from which the industry took its birth.

The career of the late Dr. Duisberg in itself gives some clue to the astonishing fecundity of the industry. An impressive feature of the brilliant discoveries of this great industrialist is their close connexion with the most recent advances of his day in organic chemistry. Equally significant is the illustration his discovery of phenacetin affords of the relation between the dyestuffs industry and other branches of the organic industry. When all allowance is made for the stimulus provided by the discovery of the therapeutic properties of acetanilide, Duisberg and Hinsberg really commenced their research through the necessity of finding an outlet for the *p*-nitrophenol which was accumulating at an alarming rate as a result of the very success of the manufacture of the benzopurpurins.

The discovery which first led the Bayer Co. into the field for which it has since become world famous has been repeated again and again in its essential features. It is the very intimacy of the links between the dyestuffs industry and other industries which makes possible the astonishing versatility of the chemist in this industry and the immense range of products which he can provide. Unless his intermediate products and by-products found outlet in other industries as vulcanisation accelerators for rubber, antioxidants for rubber or oils and fats, preservatives for wood and other materials, as gum inhibitors, for the control of insect pests and animal or plant diseases, in the manufacture of fine chemicals, pharmaceutical products, and synthetic resins, as softeners, solvents and the like for lacquers and varnishes, finishing agents of all kinds for the leather and textile agents, the resources of the industry would be severely limited by the dead weight of waste products which it would be compelled to carry.

Under modern conditions, this factor is even more important. The growing demand of the colour-using industries for novelties for specific purposes could scarcely be met in the range required or at an acceptable price but for the way in which intermediate products and by-products can be used for many different and unrelated purposes. Nor are the relations static. The reaction of the synthesis of indigo on the manufacture of indigo, and its influence on the displacement of the Weldon and Deacon processes for chlorine by the electrolytic process, are paralleled again and again within the dyestuffs industry as in its relations with other industries. For example, the introduction of sulphonated fatty alcohols as detergents has given an impetus to the use of fatty compounds for other purposes including dyestuffs, and the dyestuff chemist is no longer content to restrict himself to the use of methyl, ethyl and even butyl alcohol. The delicate balance between by-product and main product, the utilisation of waste materials, the competition of raw materials and alternative routes, is proceeding almost as freely to-day over the field of aliphatic chemistry as in the past it has done in the aromatic field.

The existence of such complex relations makes it easy to understand why a man like Dr. Duisberg could find intense satisfaction in the leadership of such an industry despite the brilliancy of his earlier scientific work. He at least could never be said to have left the field, and his career seems to underline the argument advanced by Mr. Cronshaw in support of the view that the chief factor in the decline of the industry in Great Britain—a decline which no one noticed at the time—was lack of foresight on the part of the originators of the industry themselves.

The facts speak for themselves. Perkin was a rich man when he retired in 1874 at the age of thirty-six. Nicholson retired six years earlier when forty-one, also wealthy, and though Greville Williams remained until 1877 he was then only forty-eight. On the face of it the very success of the industry was its undoing. There were no long years of drudgery and inadequate reward. The industry prospered from the start, and the dyeing trade received the new products well. The future prospects were equally bright. The textile industries were peculiarly ready for the exploitation of the new dyes. The cotton and wool trades were both on the threshold of great expansion, while Mansfield's isolation of benzene from coal tar had provided the industry with unlimited raw material on its doorstep.

Perkin, in fact, could scarcely have made his discovery at a more appropriate or auspicious time, and the explanations advanced of his withdrawal from the industry are unconvincing. He at least recognised that the dyestuffs industry was founded on scientific discovery and developed side by side with it. None the less he did not see that the greatest service he could have rendered to research in Great Britain was to retain the leadership of the industry he had brought into being; instead, the leading technologist of his day turned his back on the industry at an age when his powers of leadership should have been ripening, alike in the consolidation of results achieved and in the inspiring of other workers with his own enthusiasm.

In the light of to-day, it seems incredible that at a time when organic chemistry was still young and vigorous, and when the science as we know it to-day was rapidly taking shape on the foundations laid by Kekulé's theory, a mind such as Perkin's should have turned away from this field. The history of the next decade alone sufficiently endorses Mr. Cronshaw's words: "the industry languished because the pioneer spirit and the creative instinct which brought it into being abandoned it too early, little knowing that what they had accomplished was the merest scratch on the surface. There remained whole new worlds to conquer". Other factors there were undoubtedly,

but the charge of lack of foresight appears to be only too well founded.

Without foresight, neither in pure nor in applied science does Nature readily yield her secrets, and success in the dyestuffs industry has always depended largely on the receptivity of ideas and the creative powers which are associated with vision. The displacement of the natural colouring matters merely intensified the struggle for the survival of the fittest among the synthetic dyes themselves. In the marketing to-day of products designed to meet more and more the demands of the user in regard to shade, the fabric or purpose for which the colour is required, the conditions of fastness, the method of application and other factors, the industry depends more than ever upon the exercise of just those qualities which are inherent in all enduring scientific work. Indeed, in any scientific industry to-day success depends upon the continuous application alike in the laboratory, in the works or in the management of the assiduous search for facts, the eternal vigilance and the creative instinct and vision which are of the spirit of science itself.

Reviews

Relativity and Cosmogony

Relativity, Gravitation and World-Structure. By Prof. E. A. Milne. (The International Series of Monographs on Physics.) Pp. x+365+4 plates. (Oxford: Clarendon Press; London: Oxford University Press, 1935.) 25*s*. net.

IN 1932, Prof. E. A. Milne pointed out that, if the galaxies were initially concentrated in a small volume, those with highest speeds would by now have reached the greatest distances; we might in this way account for the well-known observational result that their radial velocities are approximately proportional to their distances. This idea has grown in less than three years into the large treatise now before us. The original idea is almost lost in the subsequent accretions; but the spirit of it remains. The outlook throughout the book is that the cosmological problem is primarily a matter of kinematics. Dynamics, wherever it appears, is treated as the servant of kinematics.

A review of the book must necessarily be a review of the theory that it promulgates. It is characteristic of modern researches on world-structure that the same physical theory is often expressed in many variant forms, both mathematical and conceptual. A confusion of tongues has descended on those who would build a tower whose top may reach unto heaven! On opening Milne's book, it is soon apparent that we shall be asked to learn a new language, but it is not so clear that the language is going to be used to describe a new world. Most of his critics have occupied themselves with the question, not whether Milne's theory is right, but whether it differs from current relativity cosmology. On this point the book is not so helpful as it might have been. Making all allowance for the author's natural desire to present his theory in his own way uncontaminated by conceptions or terminology which he dislikes, we think it is hard on the reader that he should be kept waiting until §463 to learn whether the Milne universe differs from the ordinary 'expanding universe', or whether it is the same universe described in another way. When at last we are shown that there is a definite observable difference, we are left mystified as to how the difference has arisen.

A 'cosmological principle' is placed in the forefront of the discussion, namely, that a number of equivalent observers arrive at the same description of the universe relatively to themselves—not only of its laws, but also of its actual material contents. Milne explains that this principle is merely a specification of the particular system which he has chosen to investigate, and is not supposed to be a law of Nature. To use the term 'principle' in this way seems unfortunate. When later he finds, in the system so specified, particles the properties of which are like those of cosmic rays, we congratulate him on the happy resemblance of his selected model to the actual universe. But we fail to see that he has in any way accounted for cosmic rays. The particles occur in his model because, in specifying his model, he put them there. That he did so undesignedly does not affect the question.

For the determination of location in space and time, the only means of exploration permitted is interchange of light-signals. Milne will not allow his observers to transport scales or clocks. He argues that observers elsewhere could not be provided with "rigid-length scales, copies of our own, because we could not say *a priori* what we meant by their being copies". I do not think the National Physical Laboratory would have any difficulty in issuing instructions by which an observer, say, in the Andromeda Nebula, could construct a standard metre; and I do not see the force of Milne's objection to determining lengths in all parts of the universe in this way. To exclude such methods