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TECHNICAL CHEMISTS AS "MADE IN GERMANY."

Chemische Technologie an den Universitäten und technischen Hochschulen Deutschlands. By Dr. Ferdinand Fischer, Professor in the University of Göttingen. (Braunschweig: Vieweg and Sohn, 1898.)

THIS is only a pamphlet of 54 pages, but it deals with matters of the utmost importance in the industrial struggle of this country with Germany. At intervals during the last twenty years the note of alarm has been sounded in this country with respect to the state of our chemical industries as compared with the development in this direction going on abroad, and especially in Germany.¹ The newspaper press has from time to time called attention to this matter; the modern revival in technical education has been largely influenced by such representations and, as a sign of the times, a special sub-committee was appointed by the Technical Education Board of the London County Council for the purpose of inquiring into the teaching of chemistry in London, the report of this committee having been published early last year. It is perhaps unnecessary to point out that, in spite of our recent efforts to recover lost ground, and to bring our chemical industries up to that position of supremacy which they held before the war of 1870-71, our educational machinery is still so far behind that of our Teutonic colleagues and competitors, that the German universities are now largely recruited by English and American students who are preparing for careers as chemical manufacturers. In stating that this condition of affairs is discreditable to our country, we are only paying our German friends that homage due to a nation which has all along recognised the supreme importance of the bearing of science upon industry. While we have been expending large sums in promoting "Polytechnics" of our own type, the Germans have been extending and improving their educational institutions so as to provide the highest and most specialised kind of instruction by the best experts that their country could supply. In brief, we have been "playing to the gallery" while the Germans have been addressing themselves to the private boxes and stalls; and if any doubt exists as to which kind of performance is producing the greatest effect upon the development of the chemical industries of the respective countries, we need only refer to our Patent Office records and the Board of Trade returns.

Under the title "Das Studium der technischen Chemie an den Universitäten und technischen Hochschulen Deutschlands," Dr. Fischer published a small work in 1897, from which it appears that for many years the question of introducing a general State examination for chemists has been undergoing discussion in German chemical circles. The subject has been further considered since 1897 by an Imperial Commission of inquiry (*Enquêtecommission*), composed of ministers and representatives of science and industry, and also by a union

of German chemists, composed of professors and manufacturers, at several congresses. The results of these deliberations and the views of the various authorities have all been brought together in the present pamphlet by Dr. Fischer, and we recommend our chemical manufacturers to pay very serious attention to its contents.

In plain English, Germany has taken alarm at the symptoms of revival in industrial activity and in technical education going on here and elsewhere. It is not for the writer to say whether this alarm is well-grounded or not. But the Germans are justly proud of their supremacy in this branch of industry, and they are determined to keep well to the front. In a speech made in the Prussian Parliament, on March 8 of last year, Dr. Böttinger, referring to the subject of a State examination, said:—

"Wenn auch die Fragen noch nicht definitiv erledigt sind und noch vielfach schweben, so ist doch nicht zu übersehen, und wir können die Hoffnung aussprechen, dass wir hierin etwas Positives erreichen werden, was zur Hebung Deutschlands auf diesem Gebiete beitragen wird, so dass Deutschland bleiben wird, was es bisher war: der *primus omnium* auf dem Gebiete der Chemie."

We prefer to give this and the following extracts from the same speech in the speaker's own words, as much of their force would be lost by translation:—

"Ich möchte vor Allem an den Herrn Cultusminister die Bitte richten, diese Frage, betreffend die Weiterbildung unserer Chemiker, als eine dringliche zu betrachten, und die Geldfrage nicht zu sehr in den Vordergrund treten zu lassen. Meine Herren, wir müssen vermeiden, dass wir Chemiker zweiten Ranges erziehen; wir müssen erstreben, dass auch unsere deutschen Chemiker Chemiker erster Qualität sind, dass auch für sie das Wort 'made in Germany,' wenn ich so sagen darf, eine weitere Auszeichnung ist, wie überhaupt auch die Professoren und Lehrer an unseren Hochschulen das *primus omnium* sind und bleiben" (p. 14).

"Meine Herren, ich möchte doch betonen, dass Eile Noth thut, und diese Frage nicht auf die lange Bank geschoben werden darf. Denn die im gewissen Grade souveräne Stellung Deutschlands auf dem Gebiete der Chemie wird eifersüchtigst verfolgt, vor Allem noch von Frankreich, England und Nordamerika, wo man mit aller Energie gegen uns vorzugehen sucht" (p. 17).

"Ich will nicht alles das wiederholen, auf was ich im letzten Jahre hier verwiesen, und will nur betonen, es waren nicht leere Worte, nicht leerer Schall, sondern es waren ernste Wahrheiten, die auf persönlicher Beobachtung der Verhältnisse basirt waren. Auch im vergangenen Jahre hatte ich weitere Gelegenheit, mich zu überzeugen, wie ernstlich wir aufpassen müssen. Ja, ich möchte sagen, unsere deutschen Chemiker müssen alles aufbieten, damit es heisst: *Sauve-toi*" (p. 17).

The outcome of these discussions, as Dr. Fischer tells us in the preface to his pamphlet, is a very decided expression of opinion, both by the Imperial Commission and by the German Chemical Union, that the subject of technical chemistry or chemical technology is one of essential importance to their welfare as a manufacturing nation, and that it should be more taken up by the Universities than has hitherto been the case. It is pointed out that about 95 per cent. of all chemical students become technologists, and that with the exception of Berlin and Göttingen, which possess chairs of Applied Chemistry, very few of the Universities give special recognition to this subject.

¹ See a paper by the writer of this notice in NATURE, vol. xxxiv. p. 324.

That the vaunted supremacy of Germany in chemical industry is not a mere political cry, prompted by patriotic bias, appears with stern reality in every speech or resolution recorded in the pages before us. Neither is there any hesitation in assigning this supremacy to its true causes; to State recognition of science and to the association of science with industry. The statement of Dr. Duisberg, adopted by the German Chemical Union at their Hamburg meeting, and presented to the Ministry, contains the following statements:—

“Die chemische Industrie Deutschlands, eine Quelle unseres Nationalwohlstandes, ist Dank den vereinten Bemühungen von Wissenschaft und Technik und Dank der Unterstützung, die ihr immer von Seiten der Reichs- und Staatsregierungen zu Theil geworden, auf eine Höhe gelangt, die den Neid aller mit uns auf dem Weltmarkte concurrirenden Nationen hervorgerufen und diese veranlasst hat, zur Hebung dieser Industrie und dieser Wissenschaft grössere Anstrengungen als bisher zu machen. . . . Es hiesse an unserer Nation Frevel begehen, wollten wir stehen bleiben und nicht Alles einsetzen, um im Wettkampfe der Völker auf chemischem Gebiete stets an der Spitze zu sein.”

The same point, the marching of the men of science hand in hand with the technologists, is insisted upon by Dr. Böttinger in the speech already referred to, and this authority makes the further statement that (presumably in Germany) the want of technical chemists is even now perceptible. In a former speech Dr. Böttinger told the country that the total value of the exports of chemical products amounted in 1896 to 340 million marks: he pointed out that the larger portion of the raw materials used in preparing these finished products were imported into Germany from foreign countries, and he adds this very significant remark:—

“Diese Industrie ist eigentlich ursprünglich keine deutsche gewesen. Ein grosser Theil dieser Industrie hat zuerst in England und Frankreich existirt, sie ist dann aus jenen Ländern—besonders derjenige Theil, der sich auf die höhere, auf die rein organische Chemie bezieht—zu uns herübergegangen; und wird ausschliesslich oder fast ausschliesslich heute von uns der Weltmarkt mit deren Producten versorgt.”

While unanimity prevails as to the desirability of founding chairs of technical chemistry in the German universities, the decision of the other question, the establishment of State examinations for technical chemists, is for the present deferred, since there is a division of opinion on this subject. Many of the professors of the universities and technical high schools have expressed their views, and it is obvious that the point will be a difficult one to settle when we find such names as those of Ostwald, A. v. Baeyer and Otto Witt, who are opposed to the examinational scheme, confronted by the names of Duisberg, Böttinger, Holtz, Lunge, &c., who are in favour of it.

Not the least striking feature of the speeches recorded in this pamphlet is the earnestness of the plea, put forward more especially by Dr. Böttinger, on behalf of the great national importance of chemistry, and the direct relationship of this science to various ministerial departments of the Imperial Legislature. The speaker even allows himself to be carried away by a poetical simile in comparing the unobtrusiveness of the chemist, as contrasted with

his importance, to the aroma of the violet which flowers in concealment but delights man with its fragrance. He quotes also the sayings of English statesmen like Lords Beaconsfield and Rosebery, and Mr. A. J. Balfour, who have at various times called attention to German supremacy in the chemical industries. Reference is made also, to an article in the *North American Review*, the writer of which states that the nation which possesses the best chemists is bound in the long run to come to the fore-front. Dr. Böttinger distinctly suggests a falling off in German activity in the domain of inorganic chemistry:—

“Tüchtige anorganische Chemiker muss man heute bei uns, ich möchte fast sagen, mit der Lanterne suchen; sie zu finden, ist oftmals vergeblich” (p. 33).

He deplores the migration of American students from the German high schools to Paris to learn this branch of the science; he even laments that the discovery of argon and helium did not proceed from one of their own laboratories, and he takes genuine alarm at the incursion made by the Americans into the manufacture of astronomical instruments, although, as he concedes, the glass for the lenses is of German make.

That Germany has taken alarm at the progress being made in other countries is manifest on every page of the pamphlet before us. The writer of this notice is inclined to believe that Dr. Böttinger and others take a pessimistic view of their own position; but the policy of “forewarned, forearmed” is obviously the moving principle of the present agitation. That which is of most importance to us here is the lesson conveyed by the manner in which our rivals propose to meet the competition which threatens the supremacy of their chief industry. They are urging the Government to establish chairs of technical chemistry in their universities. In this country there is a very widespread notion that technical chemistry cannot be taught in educational institutions at all. The leading chemical nation in the world has come to a different conclusion. If our chemists are anxious to know what this technical chemistry is, we commend to their notice a statement in the memorial of the German Chemical Union:—

“Technical chemistry as a branch of general chemistry is not, as is often erroneously supposed, the transference of chemical science to practical applications, but it is a science in itself . . . the flowering and thriving of which we owe to German chemical industry.”

Dr. Duisberg and others lay it down as a general principle that the students of this subject should not be taken too deeply into all the details of technology, but that they should possess a general knowledge of raw materials, apparatus and processes; that they should be made to appreciate the difference between laboratory and factory operations; that the chemistry of technical processes should be taught in special courses of lectures, and the construction of plant illustrated by exact drawings and by inspection of works.

There are many other points in this compilation of Dr. Fischer's, which are full of significance for our own country; but enough has been culled from the pamphlet to show which way things are going in Germany. We could, I am afraid, supply our Teutonic

competitors with a painful number of illustrations of methods of how not to teach technical chemistry—illustrations of the very highest (negative) value. It is often, and justly, urged by the critics of our educational methods that we are the slaves of the examination system. But there is another demon that has come into our midst of late years, which also wants exorcising—the statistical demon. The committees of most of our educational establishments seem to have the one idea that success is measured by numbers of students turned out. The following statement, by Prof. Naumann, might profitably be stereotyped into an aphorism for the use of some of our technical instruction committees and kindred bodies:—

“Der deutschen chemischen Industrie kommt es nicht auf die Zahl der gelieferten Chemiker an, sondern auf ihre Qualität.”

In concluding this notice, it is difficult to refrain from instituting a comparison between the methods adopted by the Germans and ourselves for dealing with the same problem of foreign competition. Instead of catering for the highest kind of work, and aiding existing teachers and institutions to do such work, we seem to prefer adopting a policy of broadcast smattering. If any bold advocate points to signs of decadence in any particular industry, the statistical juggler is always at hand to prove that he is mistaken. When we have achieved supremacy in any department and meet with competition, the educational machinery is the last line of our defence which is strengthened instead of being, as in Germany, the first. That we have been enabled in the past to achieve eminence without technical education is sometimes even now used as an argument that technical education is unnecessary. Our chemical manufacturers will do well to take Dr. Fischer's pamphlet, and the lesson which is contained therein, as a very serious sign of the coming struggle. So far as organic chemical products are concerned, the expression “made in Germany” is one of which that nation may now well be proud.

R. MELDOLA.

SEWAGE PURIFICATION AND SEWERAGE.

The Purification of Sewage; being a brief Account of the Scientific Principles of Sewage Purification and their Practical Application. By Sidney Barwise, M.D. (London), M.R.C.S., D.P.H. (Camb.), Medical Officer of Health to the Derbyshire County Council. Pp. xii + 150. (London: Crosby Lockwood and Son, 1898.)

Sewerage. The Designing, Construction, and Maintenance of Sewerage Systems. By A. Prescott Folwell, American Member Society of Civil Engineers. First Edition. Pp. x + 372. (New York: John Wiley and Sons. London: Chapman and Hall, Ltd., 1898.)

THE question of the hour is—What steps are to be taken for the disintegration of sewage without the addition of chemicals? Going a little outside this, Dr. Sidney Barwise has collected a certain amount of information which he thinks may be useful to his fellow medical officers of health. He points out that during recent years

“great advances have been made in our knowledge of the changes which sewage undergoes in purification, and

not a few conclusions of wide-reaching importance established; and it is hoped that the presentation in this little work of some of the results thus obtained will be found useful by engineers and others, officials who wish to avail themselves of the latest researches of chemists and biologists upon the questions of sewage purification.”

Although the work may be said in a certain sense to be an elementary text-book, it is something more, as the author has collected in handy though somewhat sketchy form a number of the more important observations on the chemistry and bacteriology of the decomposition of sewage. After describing sewage, its varieties, the changes that it undergoes, and its chemistry, Dr. Barwise indicates the effects of river pollution and the processes by which the water becomes purified; he goes on to give an account of “land treatment” of sewage, of precipitation, precipitants, and tanks, filtration or nitrification; and then describes in detail some of the special forms of sewage filters, especially Mr. Dibdin's filter, used in the experiments carried on by the London County Council; Colonel Ducat's filter, Garfield's coal filter, the Lowcock filter, and the Scott Moncrieff and Cameron filters.

Perhaps the most important feature of this work is that in which the author has attempted to compare the different sewages with which various experiments have been carried on in this country and in America. There can be little doubt that this question of comparative composition of sewage is one of great importance in determining what the various processes are capable of achieving, and therefore which process is best fitted for use in any special region. Taking the chlorine content as an index of the strength of sewage, it is evident, for example, that very different results would be obtained with any system in which an attempt is made to deal with, say, the Lawrence (Mass.) sewage, which contains 43 parts of 100,000 of total solids, and 4·8 parts of chlorine; or the Exeter sewage, with 54·4 parts total solids and 5 parts chlorine; and London sewage, which contains 123·5 parts total solids and 15·2 of chlorine; or, again, the Berlin sewage, which contains 218·3 parts of total solids per 100,000 and 21·8 of chlorine. There can be no doubt, however, that with many of the bacteriolytic methods described, remarkable results have been obtained, and statistics are given indicating the amount of purification brought about by each system; but the author very wisely in his conclusions points out that before it is possible to answer the question, “What processes shall we adopt to purify our sewage?” there must be information given as to the nature of the sewage, the facilities for disposal of sewage on land, the necessity that may arise for precipitation, the amount and nature of manufacturing waste, and the facilities that exist for complete oxidation of the effluent. The author has taken a considerable amount of trouble to collect trustworthy statistics, and were this part alone before the reader it would be worth reading; but apart from this, the book contains a considerable amount of information—in some instances loosely put together, and not always sufficiently fully set forth—and, taking the work for what it claims to be, it should prove not only of interest but of assistance to those who are engaged in advising sanitary authorities as to what measures it will be necessary to