a solution of sodium sulphide was (I.) precipitated with pure zinc chloride and the sulphur in the filtrate estimated, after oxidation, as barium sulphate. II. Another portion of the solution was run into a boiling solution of magnesium chloride and boiled until free from sulphuretted hydrogen, the residual sulphur being estimated as barium sulphate; (III.), a third portion was treated in the same way after adding a solution of 10 grms. of pure crystallised $\text{NaCN} \cdot 2\text{H}_2\text{O}$ in boiled water to it. The results were:—

Sodium sulphide used.	Residual sulphur calculated as sodium sulphide.		
	I.	II.	III.
grm. 0.162 0.013	grm. 0.0013 0.0005	grm. 0.0024 0.0002	grm. 0.0037 0.0001

It appears, therefore, that the sulphuretted hydrogen can be expelled quantitatively, and provided that a sufficiently long train of absorbing vessels is used it is easy to absorb it in the iodine solution. For example, in one test 0.0736 grm. of sodium sulphide was distilled and 0.0740 grm. found from the iodine used.

SUMMARY.

Of the three methods discussed the direct titration of sulphide by means of lead nitrate is the most rapid and simple; suitably corrected it is sufficiently accurate (for quantities of potassium sulphide under 0.1 per cent.). G. W. Williams' modification of the colorimetric method is more accurate, but it is slower, owing to the necessity of using boiled water and checking the strength of the standard sodium sulphide solution at frequent intervals. (A solution containing 2 grms. of potassium sulphide per litre, for example, lost 28 per cent. in 18 hours.) W. Feld's method is the most accurate, but it is far too slow for works' purposes, and it can only be used by a skilled operator.

I have pleasure in acknowledging Mr. Thomas Napier's skilful assistance in some of the analytical work. I am also indebted to the directors of the Cassel Cyanide Company, Ltd., for permission to publish the results.

Yorkshire Section.

Meeting held at Leeds on Monday, November 9, 1908.

MR. WALTER M. GARDNER IN THE CHAIR.

SOME CHEMICAL ASPECTS OF THE TEXTILE INDUSTRIES.

BY W. M. GARDNER.

Abstract of Chairman's Address.

In a great variety of manufactures the raw material is converted into the finished product by processes which in their essence are mechanical or chemical. More usually both mechanical and chemical operations are involved, and the two are frequently so intimately blended that the processes cannot be defined as either chemical or mechanical. For example, the manufacture of soap must be classed as a chemical industry, but the conversion of esparto grass into paper is chiefly based on mechanical treatment though involving some chemical processes, while the mechanical engineer is concerned almost exclusively with mechanical operations, though in many directions he is bound to make incidental incursions into chemical science.

The manufacture of a textile fabric is another case in which both chemical and mechanical operations are usually involved, though what may be termed the fundamental operations are mechanical. In the carding or combing and spinning processes the raw fibrous material is transformed into a coherent thread and by subsequent more

or less complex interlacings of individual threads, the woven fabric is produced. Since natural fibrous raw materials are available, a piece of cloth may thus be produced without the intervention of any chemical process whatever, and in attempting to show the great field which exists for industrial chemistry in connection with textile manufactures, one cannot be charged with selecting an industry to which chemical manipulation is fundamental.

I have selected the textile trade partly for this reason, but mainly because it is the one of which I have the most intimate chemical knowledge, and my object is to make some contribution to the discussion of the most interesting points which have been very prominently raised in recent addresses.

Much has been heard during the last few years about the decadent condition of the British chemical industries, and it has to be admitted that many notable examples can be adduced in which chemical trades, originated in this country, have been almost entirely lost to us. This has been frequently dealt with, and its causes analysed by those much more competent than I am, and my only reason for again mentioning a fact which we all deplore is to express the opinion that undue prominence given to our failures is very apt to depreciate the value of the great amount of energetic and successful work which has been and is being done in other directions.

In discussing this matter it is obviously necessary to define what is meant by the chemical industries, and this may be conveniently done by a reference to the subjects dealt with in our JOURNAL, and I claim that much misrepresentation has arisen from want of care in using this term. Surely "the shadow of the cypress" does not rest on the whole of the great industries officially recognised by this Society as chemical industries, and even as regards the minor industry (from the chemical point of view) of textile manufacture, it is easy to show that an enormous expansion of the chemical side has taken place in recent years and that an ever increasing number of well-trained chemists is in demand.

In his most interesting and valuable Presidential Address to the Chemical Society in 1907, Prof. Meldola made an eloquent and well reasoned appeal for increased facilities to be provided for the carrying out of research work in chemistry at the many Technical Colleges and Polytechnics which are provided with well-equipped laboratories. Speaking as he was to the representatives of pure chemistry, Prof. Meldola obviously had in view chemical research as distinct from technical research, and he emphasises the necessity of a training in research and the development of the research spirit which is all important in the working out of new processes.

In regard to many branches of the textile industries it is very satisfactory to be able to say that in several of the larger Technical Colleges much work in the nature of technical research is carried out by the advanced students and is often followed up by investigation for improving or cheapening processes when the students obtain positions in works. In this way both staff and students are being kept in intimate contact with the industries concerned.

In connection with this question of research work it may be interesting to record that at any rate some of the local education authorities who are now mainly responsible for the Technical Colleges, are realising the responsibility resting upon these Institutions to add their quota to the sum of knowledge; and in the Institution over which I have the honour to preside (the Bradford Technical College) a highly qualified lecturer has recently been appointed specifically to devote his time to chemical research.

Turning now to a short review of the chemical industry of textile manufactures, it may be fairly claimed that the chemist has made some remarkable contribution both as regards the actual provision of raw materials, the production of new decorative effects, and in imparting new and valuable properties to fabrics.

In the matter of raw material one textile fibre, artificial silk, is of purely chemical origin. It is invariably made from cellulose as a raw material, this being brought into solution in various ways and subsequently regenerated in the form of fine filaments. Chardonnet's original

process (1889) was to convert cellulose into the tri- and tetra-nitrate, which was dissolved in alcohol-ether; the solution was then forced through very fine orifices into a heated chamber, which volatilised the solvent. The filaments were then "denitrated" in various ways.

The great defects of artificial silk as a textile raw material have been its low strength, its poor covering power, and the difficulty found in its manipulation, but these defects have now been largely eliminated.

The chemist has also enriched the textile industries by the production of what is practically a second new fibre by the invention of the "lustring" of cotton by mercerisation. This process, which imparts to cotton very much the appearance of silk, was initiated and developed in this country. The dyeing properties of the mercerised cotton also differ materially from those of ordinary cotton.

Other chemical treatments of the various textile fibres are employed for producing special effects or special properties. For example, by different treatments the dyeing properties of fibres may be entirely altered. In response to the offer of a prize of £10, Messrs. C. F. Cross and Briggs submitted a process by which cotton may be made to resist (that is, will not dye with) direct colours such as the benzidine dyes. The process consists in treating the cotton with acetic anhydride, acetyl chloride, and zinc chloride, and the acetylated cellulose has quite peculiar and valuable properties in several directions. The discovery of this process has no doubt been of considerable service to the patentees as well as to the trade generally, and this example may serve to illustrate the nature and value of chemical research of a technical nature as applied to the textile industries and incidentally the value of bringing the trade problems to the notice of chemists by means of journal publication.

Other directions in which chemical treatment of fibres has been of great value are the production of unshrinkable wool fabrics and unflammable cotton materials, both of which have been the subject of a great amount of technical research before success was attained.

Wool washing is the process of removing from wool fibre the natural grease with which it is encrusted. This is done by emulsifying the grease by means of a solution of soap and alkaline carbonate. The process gives rise to very large volumes of waste liquors which contain much free and combined fat. If these liquors are run into the sewers in considerable quantity they greatly complicate the work of the sewage engineer, as in fact is the case in Bradford, where about £12,000 per annum

is expended for sulphuric acid with which to separate the fatty matter from the sewage.

The recovered fat has a value of about £5 10s. to £6 per ton and about 40 tons per week is recovered from the Bradford sewage. In the larger wool-washing works, the suds are treated before running to waste, and the grease converted into soap, lubricating oil, and lanolin. In one works in Bradford (not the largest) as much as 50 tons of grease per month is recovered, its value being £9 to £10 per ton. This is a particular case of the large chemical question of the treatment of effluents, in which direction much investigation is proceeding and which is one of the important features of the work of a chemist in textile works.

Leaving aside the chemical work involved in such processes in textile manufacture as bleaching, dyeing, printing, etc., which is too extensive a subject to be touched upon, reference may finally be made to one most important branch of the work of a chemist in any textile works, viz., the investigation of defects which may arise at any stage of manufacture.

The work involved in such investigations is often of great interest and of very wide scope. It frequently happens that any solution of the difficulty is impossible in the absence of an acquaintance with the whole range of operations—mechanical as well as chemical—through which the material has passed. It is in fact research work of no mean order and the carrying out of such work by advanced students is the most valuable kind of training. From its very nature much of the work is unsuitable for publication and commercial considerations usually prohibit publication in any case. It appears to me, however, that in carrying out technical research of this character, works chemists and Technical Colleges are fulfilling their truest function. In the case of teaching institutions it provides for the all important necessity of keeping in close touch with the industries they serve.

If it were possible to give publicity to investigations of this character, I feel sure that criticisms of the small amount of original work carried out in Technical Colleges would not be so severe.

I have attempted to show that even in apparently remote directions, such as the textile trade, there is a wide scope for chemical research and abundant opportunity for the employment of well trained (if specially trained, chemists. Chemistry is permeating the textile industry and the outlook for the future of this great industry is very hopeful, even from the chemical student's point of view.

Journal and Patent Literature.

PATENT SPECIFICATIONS may be obtained by post by remitting as follows:—

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I.—PLANT, APPARATUS, AND MACHINERY.

PATENTS.

Dryer; A mechanical rotary or revolving — for removing and expelling moisture from meagss, sawdust, sand, and particles of various substances. L. Jones, London. Eng. Pat. 25,131, Nov. 13, 1907.

A DRUM, *a*, provided with vanes, *b*, forming compartments, *l*, is rotated in a flue, *g*, through which the heating medium is transmitted. By means of a damper, *h*, the volume of heating medium passing round the drum may be regulated. The material to be dried is fed through an opening in the end of the drum on to a distributor-plate, *i*, which can be rotated about the axis, *j*, by the external lever, *k*. When charging, the distributor is fixed in the inclined position shown, and the material falls into the compartments, *l*, as they pass below its lower edge. When half the compartments are charged the feeding is stopped, and the rotation continued. As each compartment attains

the highest position, its contents are dropped on to the distributor, *i*, and are conducted into the compartment