SCIENCE

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CONTENTS

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THE CONTRIBUTION OF THE CHEMIST TO THE INDUSTRIAL DEVELOPMENT OF THE UNITED STATES[1]

SINCE the outbreak of the European War, the American public has been led, adroitly or otherwise, to believe that industrial chemistry, that is, the industrial activity of the chemist, is limited to coal-tar dyes and that nothing should be regarded as industrial chemistry that does not deal with the manufacture of these dyes. Nothing could be further from the truth.

While it is true that the manufacture of coal-tar dyes forms an important branch of industrial chemistry, or of chemical industry, whichever you will, it by no means forms the whole of it or even a preponderating part of it.

From the economic point of view, economic effect and economic result is the measure to apply in determining economic importance and not the intellectual or scientific labor involved in the creation of that result.

From a strictly economic point of view coal-tar dyes can hardly be said to be vital or essential and by that I mean that we can get along without them and not suffer great hardship, personal or otherwise; anything of less need than that can hardly be called an economic necessity.

THE CHEMIST AND HIS WORK

The American public has seemingly given too little consideration to those industries of this country that make use of chemical knowledge and experience in the

[1] From the public address at the fiftieth meeting of the American Chemical Society, New Orleans, March 31 to April 3, 1915.

manufacture or utilization of products and yet these are the ones that compose chemical industry or industrial chemistry.

For the present, permit me to give in a few words the substance of the impressive series of papers presented at the meetings of this forenoon and this afternoon, and, as this presentation is being made, please have in mind the question as to whether you would prefer to have the United States able to produce all of its requirements of coal-tar dyes and *not* able to produce any of the various things which I am about to mention.

According to this symposium there are at least nineteen American industries in which the chemist has been of great help, either in founding the industry, in developing it, or in refining the methods of control or of manufacture, thus rendering profit more certain, costs less high and output uniform in standard amount and quality.

The substitution of accurate, dependable and non-failing methods of operation for "rule of thumb" and "helter-skelter" methods must appeal to every manufacturer as a decided advancement and a valuable contribution.

NINETEEN AMERICAN CHEMICAL INDUSTRIES

In presenting to you these various contributions of the chemist, I by no means wish to be understood as in any wise minimizing or reducing the contributions made to the final result by others, such as merchants, bankers, engineers, bacteriologists, electricians, power-men and the like; all that I wish to emphasize is that the chemist *did* make a contribution, and to that extent he is entitled to credit and acknowledgment.

The chemist has made the *wine industry* reasonably independent of climatic conditions; he has enabled it to produce substantially the same wine, year in and year out, and no matter what the weather; he has reduced the spoilage from 25 per cent. to 0.46 per cent. of the total; he has increased the shipping radius of the goods and has made preservatives unnecessary.

In the *copper industry* he has learned and has taught how to make operations so constant and so continuous that in the manufacture of blister copper valuations are less than $1.00 apart on every $10,000 worth of product and in refined copper the valuations of the product do not differ by more than $1.00 in every $50,000 worth of product. The quality of output is maintained constant within microscopic differences.

Without the chemist the *corn products industry* would never have arisen and in 1914 this industry consumed as much corn as was grown in that year by the nine states of Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, New Jersey and Delaware combined; this amount is equal to the entire production of the state of North Carolina and about 80 per cent. of the production of each of the States of Georgia, Michigan and Wisconsin; the chemist has produced over 100 useful commercial products from corn, which, without him, would never have been produced.

In the *asphalt industry* the chemist has taught how to lay a road surface that will always be good, and he has learned and taught how to construct a suitable road surface for different conditions of service.

In the *cottonseed oil industry,* the chemist standardized methods of production, reduced losses, increased yields, made new use of wastes and by-products and has added somewhere between $10 and $12 to the value of each bale of cotton grown.

In the *cement industry,* the chemist has ascertained new ingredients, has utilized theretofore waste products for this purpose, has reduced the waste heaps of many industries and made them his starting material; he has standardized methods of manufacture, introduced methods of chemical control and has insured constancy and permanency of quality and quantity of output.

In the *sugar industry,* the chemist has been active for so long a time that "the memory of man runneth not to the contrary." The sugar industry without the chemist is unthinkable.

The *Welsbach mantle* is distinctly a chemist's invention and its successful and economical manufacture depends largely upon chemical methods. It would be difficult to give a just estimate of the economic effect of this device upon illumination, so great and valuable is it.

In the *textile industry,* he has substituted uniform, rational, well thought-out and simple methods of treatment of all the various textile fabrics and fibers where mystery, empiricism, "rule of thumb" and their accompanying uncertainties reigned.

In the *fertilizer industry,* it was the chemist who learned and who taught how to make our immense beds of phosphate rock useful and serviceable to man in the enrichment of the soil; he has taught how to make waste products of other industries useful and available for fertilization and he has taught how to make the gas works contribute to the fertility of the soil.

In the *soda industry,* the chemist can successfully claim that he founded it, developed it, and brought it to its present state of perfection and utility, but not without the help of other technical men; the fundamental ideas were and are chemical.

In the *leather industry,* the chemist has given us all of the modern methods of mineral tanning and without them the modern leather industry is unthinkable. In the case of vegetable-tanned leather he has also stepped in, standardized the quality of incoming material and of outgoing product.

In the *flour industry* the chemist has learned and taught how to select the proper grain for specific purposes, to standardize the product and how to make flour available for certain specific culinary and food purposes.

In the *brewing industry,* the chemist has standardized the methods of determining the quality of incoming material and of outgoing products, and has assisted in the development of a product of a quality far beyond that obtaining prior to his entry into that industry.

In the *preservation of foods,* the chemist made the fundamental discoveries; up to twenty years ago, however, he took little or no part in the commercial operations, but now is almost indispensable to commercial success.

In the *water supply of cities,* the chemist has put certainty in the place of uncertainty; he has learned and has shown how, by chemical methods of treatment and control, raw water of varying quality can be made to yield potable water of substantially uniform composition and quality.

The *celluloid industry,* and the *nitrocellulose industry,* owe their very existence and much of their development to the chemist.

In the *glass industry* the chemist has learned and taught how to prepare glasses suitable for the widest ranges of uses and to control the quality and quantity of the output.

In the *pulp and paper industry* the chemist made the fundamental observations, inventions and operations and to-day he is in control of all the operations of the plant itself; to the chemist also is due the cheap production of many of the materials entering into this industry as well as the increased and expanding market for the product itself.

THE STATISTICAL POSITION

For the census year of 1909 the wage-earners and the value of manufactured products and the value added by manufacture in twelve of these industries and in the manufacture of chemicals is given in Table I*a*.

this amounts to about 15 cents per person per year.

Now, which would you rather have, these thirteen industries with their $2,500,000,000 worth of manufactured product or the coal-tar dye industry with its $100,000,000 of product? The number of persons employed in these above thirteen industries is in excess of 500,000; the entire world's supply of coal-tar dyes is made by fewer than 40,000 people. Which would you rather have?

TABLE I*a*

	Wage-earners	Product Value	Value Added by Manufacture
Wine	1,911	$13,120,846	$6,495,313
Copper	15,628	378,805,974	45,274,336
Fertilizer	18,310	103,960,213	34,438,293
Textiles	44,046	83,556,432	48,295,131
Canned and preserved foods	59,968	157,101,201	55,278,142
Cotton-seed oil	17,071	147,867,894	28,034,419
Cement	26,775	63,205,455	33,861,664
Sugar	20,730	327,371,780	52,523,806
Brewing	54,579	374,730,096	278,134,460
Leather	62,202	327,874,187	79,595,254
Glass	68,911	92,095,203	59,975,704
Paper and wood pulp	75,978	267,656,964	102,214,623
Chemicals (strictly)	23,714	117,688,887	53,567,351
Totals	529,823	$2,455,035,132	$897,688,496

TABLE I*b*

Iron and steel	278,505	$1,377,151,817	$399,013,072
Petroleum refining	13,929	236,997,659	37,724,257
Lead smelting and refining	7,424	167,405,650	15,442,628
Illuminating and heating gas	37,215	166,814,371	114,386,257
Confectionery	44,638	134,795,913	53,645,140
Paint and varnish	14,240	124,889,422	45,873,867
Soap	12,999	111,357,777	39,178,359
Carpets and rugs	33,307	71,188,152	31,625,148
Explosives	6,274	40,139,061	17,328,113
Zinc smelting and refining	6,655	34,205,894	8,975,893
Turpentine and rosin	39,511	25,295,017	20,384,174
Oil cloth and linoleum	5,201	23,339,022	7,788,921
Chocolate and cocoa	2,826	22,390,222	8,867,162
Baking powder and yeast	2,155	20,774,588	11,436,603
Dyestuffs and extracts	2,397	15,954,574	6,270,923
Blacking, cleansing and polishing preparations	2,417	14,679,120	7,716,728
Wood distillation other than turpentine	2,721	9,736,998	3,861,147
Oleomargarine	606	8,147,629	1,650,997
Totals	513,020	$2,605,262,886	$829,052,389
Total for 31 chemical industries	1,042,843	$5,060,298,015	$1,726,740,885
Total for all industries	6,615,046	$20,672,051,870	$8,529,260,992

AMERICAN INDUSTRIES VS. COAL-TAR DYES

A most liberal estimate of the market value of the world's entire production of coal-tar dyes places it under $100,000,000; the entire consumption in the United States is less than $15,000,000, duty included, and

These thirteen industries employ 8 per cent. of all wage-earners in manufacturing enterprises in the United States, produce 12 per cent. of the total value of manufactured product and 10.5 per cent. of the total value added by manufacture. In other words, the chemist engaged in these thirteen pursuits plays an important, if not indispensable part in the lives of 8 per cent. of our wage-earners and affects 12 per cent. of our manufacture-values and 10.5 per cent. of our values added by manufacture. But the total number of chemists makes up only about 0.01 per cent. of the population of the United States.

NO NATION CAN DO EVERYTHING ITSELF

Of course, it may be said that having made all these other things, there is no excuse why the American should not make coal-tar dyes in addition. Perhaps so; but nations, like individuals, can not each have or do everything. If each nation could do everything equally as well as every other nation, there would be no occasion whatever for international business. As this world is constituted, each nation does that which it can do the best and trades off the product for what some other nation can do better than it, and both sides are satisfied and make a profit; this is the same as the relationship between individuals. The shoemaker can make shoes better than he can bake bread; he makes shoes and exchanges part of his income with the baker for bread which the baker has made.

If American chemists can operate these industries better than or as well as other nations, it is no real ground for criticism that they can not do everything better than any other nation, any more than the shoemaker is to be criticized because he can not make as good a suit of clothes as can the tailor. If you want the shoemaker to be able to make a suit of clothes as well as the tailor you must provide him with the opportunity to learn how to tailor and take care of him while he is learning, and no doubt his suit of clothes will cost him more than it would cost an established tailor to turn out the same kind of a suit of clothes, and you must again help your shoemaker while he is trying to market his suit of clothes against the established tailor.

EIGHTEEN ADDITIONAL AMERICAN CHEMICAL INDUSTRIES

The above nineteen American industries referred to by no means comprise all the American industries in which the chemist can be of help and of assistance. Many more are open.

A search through the census for 1909 discloses the eighteen additional industries listed in Table I*b* which make use of chemists in the control of their operations.

In these eighteen additional industries the chemist affects 8 per cent. of our wage-earners, 12.6 per cent. of our manufacture values and 9.7 per cent. of our values added by manufacture. For these thirty-one industries, then, the 0.01 per cent. of chemists of our population directly affect 16 per cent. of our wage-earners, 24.6 per cent. of our manufacture values and 20.2 per cent. of our values added by manufacture.

This, therefore, is a measure of the influence of the chemist upon the industrial development of the United States; however gratifying this result is, it is nevertheless true that many other industries could employ chemical control to great advantage, if they only would, and many establishments under the above cited industries could, if they would, make use of chemical control. There is plenty of work left for the chemist to do in these industries to keep him fully and profitably engaged. This being so, why should he not continue to direct his energies to improving those things that he already can do, rather than attempt new and exotic things which others can do better than he?

THE FOREIGN BUSINESS

So much for our internal relations. How about our international relations? To answer this question I will use the official classification of the German government as to what constitutes products of and for chemical industry and also the same government's corresponding figures for 1913.

No two countries, speaking through their statistical departments, have the same working definition of chemical industry. None of the official classifications is as comprehensive as is the official German classification. So far as the exchange of products and commodities involved in chemical pursuits is concerned, the German classification shows a total of 442 items of which 229 are involved in international trade between Germany and the United States. According to these figures and this classification, the United States imported from Germany in 1913, $60,860,880, and exported to Germany $156,036,090, or a total business of $216,896,970, with a balance in favor of the United States of $95,175,210. I have selected from this 1913 list of items of business between Germany and this country those whose gross is $400,000 per annum or over (Table II).

It is interesting to note that we sell Germany more lard than Germany sells us of potash and aniline and other coal-tar dyes put together; that we sell Germany half again as much refined petroleum as it sells us aniline and other coal-tar dyes; that we sell Germany practically the same amount of pig and scrap lead as Germany sells us of alizarin and anthracene dyes; that we sell Germany almost as much paraffine as Germany sells us of indigo; and so on through the list.

RELATIVE QUALITIES OF IMPORTS AND EXPORTS

Of course, it will be contended that the things that we sell Germany are, from a chemical point of view, less refined, *i. e.*, involve less hard chemical intellectual work than do our imports from Germany. But, is most of the potash, which is practically mined from the ground in Germany, any more of a refined product than the phosphate rock we sell them? Does it not involve quite as much chemical ingenuity to produce good illuminating oil from petroleum as it does to produce many of the coal-tar dyes? There is no question that the general position above outlined is correct, namely, that our products, as a whole, are less refined than those that we get, as a whole, from Germany, but is that not true practically throughout our entire export and import business? Are not the textiles we export of a lower grade than those we import? Are not our leather products less refined than those we buy? And so on down the list. That being so, why pick out the chemist as a special mark for criticism when he is at least up to the average of his surroundings?

In 1913 the total foreign business of the United States amounted to $4,277,348,909, and the excess of exports of all kinds over imports of all kinds amounted to $691,271,949.

The trade in chemicals and products of and for chemical industry between the United States and Germany in 1913 furnished 5 per cent. of that total of international business and provided 13.8 per cent. of the balance of trade.

THE INFLUENCE OF THE CHEMIST

The symposium of papers presented today constitutes a record of proud achievement, of solid accomplishment in nineteen different branches of American industrial activity, to which advance the application of chemical knowledge, chemical principles and chemical experience by American chemists, has contributed a noble share and an effective part. It is perhaps true that much of that progress would have come without the American chemist, but it is

TABLE II

U. S. Chemical Trade with Germany (1913)

U. S. Imports from Germany	Value in U. S. Money	U. S. Exports to Germany
	$75,000,000	1 Copper
	26,700,000	2 Lard
1 Potash salts	18,819,000	
	12,690,000	3 Refined petroleum
2 Aniline and other coal-tar dyes	7,290,000	
	4,970,000	4 Phosphate rock
	4,880,000	5 Oleomargarine
	4,585,000	6 Turpentine rosin
	4,460,000	7 Mineral lubricants
	3,840,000	8 Spirits turpentine
3 Caoutchouc	2,582,000	
	2,220,000	9 Crude benzine
	2,171,000	10 Beef tallow (prime)
	1,744,000	11 Nickel and nickel coin
4 Straw, esparto and other fibers; paper stock	1,649,000	
	1,550,000	12 Cotton-seed oil
5 Alizarin and anthracene dyes	1,463,000	
	1,421,000	13 Pig lead and scrap
6 Indigo	1,319,000	
	1,231,000	14 Crude and hard paraffin
	1,162,000	15 Acetate of lime
7 Platinum and allied metals	1,120,000	
8 Hops	952,000	
9 Miscellaneous volatile oils	941,000	
	903,000	16 Tin and tin scrap
10 Tin and tin scrap	900,000	
11 Potassium and sodium cyanide	845,000	
12 Chrome, tungsten, etc.	784,000	
13 Superphosphates	766,000	
	724,000	17 Crude wood alcohol
14 Beet sugar, refined	716,000	
	695,000	18 Carbides
	673,000	19 Miscellaneous volatile oils
15 Alkaloids exc. quinine	672,000	
16 Toilet and tooth powders	658,000	
	656,000	20 Heavy benzine and patent naphtha
17 Lime-nitrogen, etc.	635,000	
18 Potash carbonate	632,000	
	617,000	21 Lubricants of fats and oils
	579,000	22 Beef and mutton tallow
19 Ferro-Al, Cr, Mn and Ni	567,000	
20 Potassium magnesium sulfate	509,000	
21 Gold ores	506,000	
	506,000	23 Copper alloys
22 Beet sugar, raw	492,000	
23 Aniline oil and salt	476,000	
24 Bronze and metal colors	473,000	
25 Glue	471,000	
26 Aluminum plates and metal	454,000	
27 Quinine and its salts	436,000	
	422,000	24 Portland cement
28 Terpineol and allied synthetics	409,000	
29 Gelatin	403,000	

equally true that under those conditions the advance would have been much slower and also much of what has been accomplished would never have happened at all without the faithful, enthusiastic and alert cooperation of the American chemists on the job. With such a record, the American chemist can hold up his head with pride and self-confidence, firm in the belief, and warranted in his conviction that he has done a man's work, in a man's way, that he has not been an idler, nor a sloth, nor a drone, but that he has been one of the busiest of busy workers, with a keen eye and an alert intellect, always searching for an opportunity for the betterment of his industry, and for improvement of the conditions of his fellowman.

GERMAN SUPREMACY

That the chemist has not done more is by no means due to any unwillingness. It is due in the largest part to the apathetic attitude of those in charge of the management of many of our industrial enterprises requiring chemical knowledge in their exploitation. Many of these men in responsible positions do not have a chemical education even along the lines in which they are financially active. In those cases chemical novelties and chemical problems are not passed upon, on their merits, by chemists or by men with a chemical point of view, but by merchants, by lawyers and by bankers, men who, by their very training, are not capable of taking the chemist's point of view, of having the chemist's sense of proportion, and are unwilling to take a chemist's chance in a chemist's way. Therein lies, perhaps more than in any other one thing, the reason for Germany's supremacy in most of the branches of chemical industry. That also is the reason for the success of a great many of our own huge transportation, electrical and chemical enterprises. The business is run by men who know it from the technical point of view. Railroads are run by men who know the railroads from the operating and construction point of view; electrical enterprises by men who know the business from the electrical engineer's point of view, and they make their enterprises take their business chances in a transportation way, and in an electrical way. Practically all of our chemical enterprises that have been managed in the same manner have also been successful, but there is still great room for improvement, and just as soon as that improvement is accomplished, just so soon, and no sooner, will there be less and less talk about the incompetency of the American chemist. German chemical enterprises are run and managed by chemists.

Some years ago I was thrown in company with a very successful meat packer, and a very successful metallurgist; the packer asked me when chemists would make glycerin synthetically and make it cheap, as the price of glycerin was getting to be altogether too high; the metallurgist asked me, rather impatiently, what elements make up glycerin; somewhat dazed, I replied, "Carbon, hydrogen and oxygen." Thereupon the metallurgist said to the packer, "Why, carbon is coal, hydrogen and oxygen are water, both are plentiful and cheap; I do not see why these chemists can not mix coal and water and produce glycerin." I felt that my life was altogether too short to attempt to educate those two very successful men to a proper appreciation of the difficulties of converting coal and water into glycerin. This metallurgist's answer to the packer might with equal truth have referred to such dissimilar things as wood alcohol, grain alcohol, vinegar, olive oil, castor oil, whale oil, starch, camphor, cane sugar, beet sugar, grape sugar, carbolic acid, alizarin, and host upon host of similarly different things. I do not know whether that packer, when he got home, told his chemist to take a hunk of coal and drop it into a bucket of water, and make glycerin. I hope, for the chemist's sake, that he did not give him that task.

THE RESPONSIBILITY OF MANAGERS

If there is such a misconception of the chemistry underlying their own products of manufacture on the part of many of our manufacturers, as this meat packer displayed, and if the general chemical viewpoint of the managers of many of our chemical industries is as confused and unfounded as was the view of this metallurgist, then it is no wonder that American chemical enterprises are behind some other countries; the real wonder is that we have any chemical industry at all. Nor is there any dearth in this country of properly trained chemists. There are almost ten thousand of them now in the United States, and they are being turned out by our technical and other schools with great regularity and with increasing volume every year. The fault is not with the American chemist, nor with his ability, nor his willingness; the fault lies principally and almost wholly with those in charge of many of our industrial enterprises, who fail absolutely in a chemical understanding of their own products and are devoid of any sympathetic contact with chemistry and with chemical points of view and therefore are incapable of, and unable to appreciate the value of chemical work or to have a wholesome understanding of the snares, the pit-falls and the tedium of chemical research.

CHEMISTS IN MANAGERIAL POSITIONS

This plea for the wider introduction of chemists in positions of managerial responsibility is, however, not to be interpreted into a statement that any kind of a chemist can do any kind of a chemical job. Just because a man can swing a scythe and cut wheat rapidly is no reason why he should be entrusted with the job of giving a man a shave; therefore, if you have a cotton oil problem, do not give it to a man whose specialty and training is in iron and steel only. The non-chemical managers of chemical enterprises will have their hands full picking out the right chemist for the right job and training promising chemical material for managerial positions. To do this successfully is quite an undertaking and will not be accomplished without many trials and many failures. Why should there not be failures? Not every man who is sent out on the road makes a successful traveling salesman, nor is every man put in as a superintendent a success as a superintendent.

In selecting your chemist for a responsible position, you must look out that you do not get a square peg for a round hole, just as you would when engaging a man for any other position, but the trouble seems to be with many of those who have engaged chemists, that they have not appreciated that there are chemists and chemists; they seem to have some sort of an idea that there is a magic about what a chemist does. Now, there is no magic at all. It is all plain, hard work, that calls for a lot of intellectual effort, and above all, the application of common sense, which, as every one knows, is a very rare article.

THE RESPONSIBILITY OF THE PUBLIC

With this record of solid achievement placed before you to-day, together with what I have just said, I hope that the conviction will finally break through, and will penetrate the public mind as well as the minds of those in charge of many of our industrial establishments, that if the American chemist is not doing as much as the public expect him to do, it is because the public through its industrial enterprises has deliberately declined to give him a chance. With this wonderful record of fruitful endeavor is the American chemist to have his chance? The answer to that question is largely in the hands of the American public.

However, the public will have to acquire in some dependable way an appreciation of what the chemists' work stands for and really is. There are numerous difficulties in the way. By its very nature, the work of the chemist is more or less concealed from public inspection. If you have a particularly well tanned piece of leather, the layperson thinks no further than that it is a pretty good job, and is utterly unable to appreciate the large amount of work that has been necessary to produce or to create the way of making that particularly good piece of leather. There is nothing so conspicuous about the chemist's work as there is, for example, about the bridge builder's work, or about the work of a man who erects a skyscraper. The chemist's work, as a whole, does not fill the eye nor appeal to the imagination; and not filling the eye, and not appealing to the imagination there is really no practical method of valuation easily accessible to the ordinary individual; not only is the ordinary individual incapable of such a valuation, but even men high in industrial pursuits have not that particular intellectual vision which permits them to appreciate the real significance behind any given chemical product. The only exception hereto seems to be coal-tar dyes.

The reason for this exception is not hard to find. Could anything appeal more to the imagination than the conversion of such a disgusting, sickly mess as coal tar into brilliant colors that rival and excel every tint and shade in nature?

THE RESPONSIBILITY OF THE CHEMIST

However, the chemist must not attempt to absolve himself from all responsibility for the prevailing lack of appreciation or skepticism among capitalists and bankers of the value of chemical work in industrial operations. While competent chemists and chemical engineers by their very effective work have wrung from reluctant financial men proper acknowledgment of the value of chemical examination, control and management of enterprises requiring such, yet the work has not gone far enough, and it is not at all unusual for financial men to support with might and main enterprises which any qualified chemist or chemical engineer could and probably did tell them were foredoomed; also it must not be forgotten that qualified chemists and chemical engineers, like other professional advisers, have gone astray in their calculations and have supported enterprises which ultimately failed. The mining, electrical and railroad engineers finally succeeded in obtaining their present influential position among the industrial councils of this country and with the brilliant success of the chemical engineers of Germany in the same direction it is not too much to hope that ultimately the American chemist and chemical engineer will come into his own. When he does, there will be far fewer exploitations than heretofore of the wild and fantastic schemes of chemical enterprise now so easily financed by the gullible portion of our investing public and fewer and fewer failures of chemical enterprises undertaken in good faith and serious mood.

Therefore, let every chemist in advising on chemical operations prominently bear in mind that failure to give correct advice not only reacts upon him but upon each and every member of the chemical profession and merely helps to postpone the day when the chemist will come into his proper position among the makers of the nation.

CONCLUSION

To bring the matter up squarely before you let me recapitulate: The 10,000 chemists in the United States are engaged in pursuits which affect over 1,000,000 wage-earners, produce over $5,000,000,000 worth of manufactured products and add $1,725,000,000 of value by manufacture each year; the business in products of and for chemical industry between the United States and Germany alone in 1913 provided 5 per cent. of our total foreign business and 13.8 per cent. of our balance of trade for that year. Please bear in mind that I am not by any means attempting to claim all the credit for this for the chemist; all that I ask is that his claims to recognition for intelligent, active and effective collaboration in bringing about those stupendous results be not thrown aside as worthless and that he shall not be made the target of unjust criticism because in 1914 there was a shortage of about $600,000 or 7 per cent. in coal-tar dyes and because cotton dropped from 15 cents to 6 cents.

Much more could be said of the chemist and his contribution to the effective every day labor of this work-a-day world but time and space forbid. I am sure that this short sketch of the chemist's activities, his hopes, his aims and his work will serve to create a wider interest in him and will result in according to him the credit to which he is entitled, namely, that he pulls more than his own weight in our nation's boat.

Bernhard C. Hesse

THE GRAY HERBARIUM

The rebuilding of the Gray Herbarium, which has been in progress for some years, has just been finished by the completion of the main central section of the building. The original structure, the gift of Nathaniel Thayer in 1864—at which date Dr. Asa Gray gave his invaluable botanical collections to Harvard University—was a brick building and for its time substantial, but the entire interior finish, including the floors, the plant cases, book shelving, etc., was of wood. The building had become wholly inadequate for the growing collections and was far from being fireproof in any modern sense.

The complete rebuilding and considerable enlargement was begun in 1909 and has been carried out a section at a time. It has been effected through the generosity of members of the visiting committee. The initial step consisted in the erection of a substantial ell, known as the Kidder wing, the gift of Mr. Nathaniel T. Kidder, of Harvard, '82. This wing, completed in 1910, provided convenient shelving space in exceptionally secure cases for more than 300,000 sheets of herbarium specimens as well as a portion of the library, thus giving great relief from the congestion of the older building.

In 1910 the adjacent residence, formerly occupied by Dr. Gray, was moved to the opposite side of Garden Street, and in its place was built in 1911 the Library wing of the herbarium. This portion of the building, furnishing ample quarters for the convenient shelving of the library, with extensive provision for its growth, was given anonymously and was completed in 1912. Last year, however, the donor, Dr. George Golding Kennedy of the Harvard class of '64, kindly consented that his name might be announced in connection with the fiftieth aniversary of the graduation of his class.

This wing contains, besides the library, the private offices of the curator, Professor B. L. Robinson, and the librarian, Miss Mary A. Day, a room for maps, files and publications, and, in the basement, a press-room for the drying and preparation of specimens, a photographic dark-room, a staff-room and store room.

At the same time, the old and wholly inadequate laboratory and auditorium, which had formed the opposite wing of the earlier structure and had been built in 1871 by the gift of Horatio Hollis Hunnewell, were taken down and replaced by the George Robert White Laboratories of Systematic Botany, a wing of much greater capacity, well arranged, well lighted and provided with complete and highly perfected equipment for its purposes. This wing, the gift of Mr. George Robert White, of Boston, contains on the ground floor two laboratories, one used by the Harvard students in systematic botany, the other by the Radcliffe students. On the second floor, there is an instrument room, a "bundle-room" for the safe storage of collections awaiting study,