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CHEMISTRY

The Basis of Industrial Progress

BY

Right Hon. Sir GEORGE E. FOSTER, P.C., K.C.M.G.

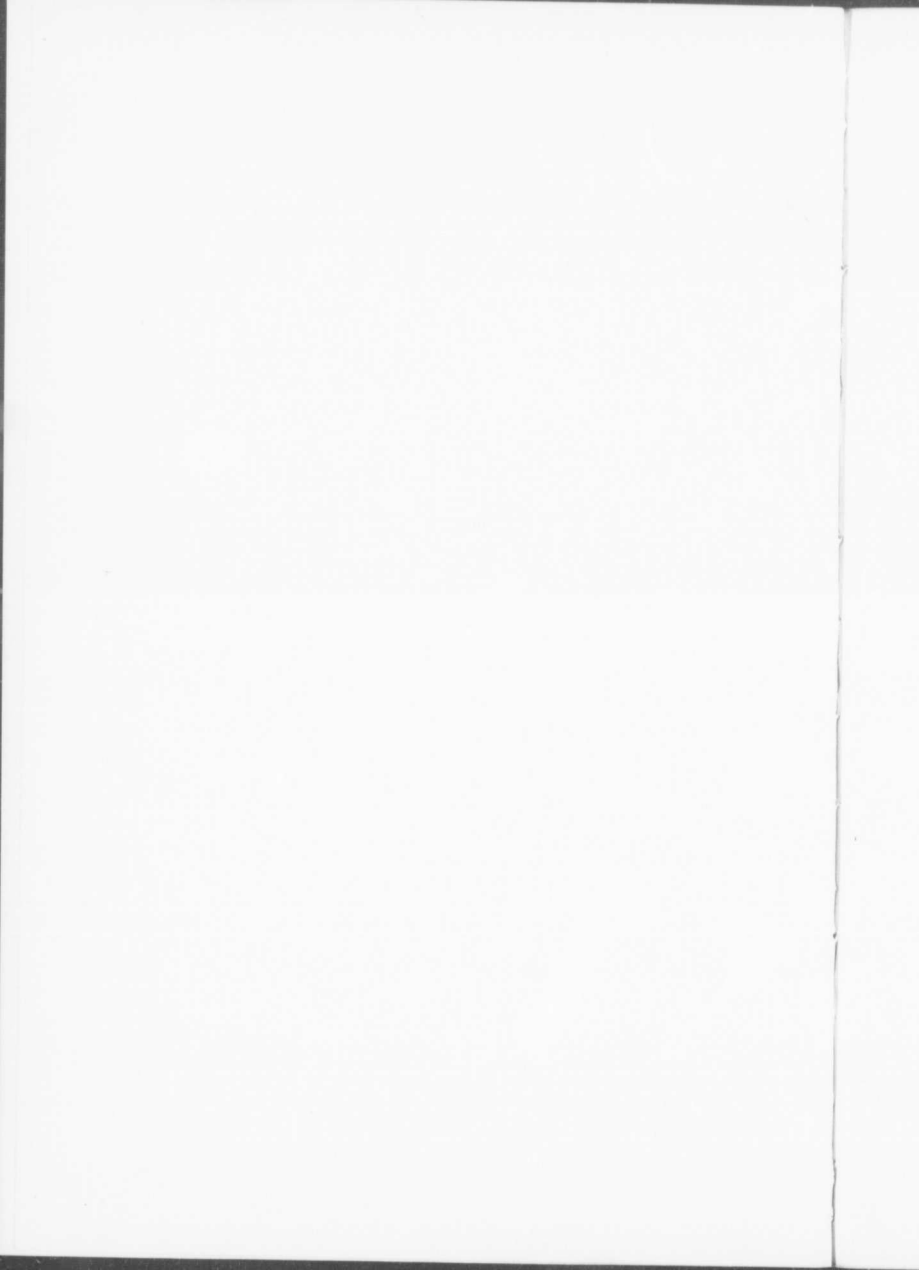
From Sir G. E. Foster



An address delivered before the Ottawa Branch, Canadian
Section, Society of Chemical Industry,
December 17, 1919.

Reprinted by the Honorary Advisory Council for Scientific
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CHEMISTRY THE BASIS OF INDUSTRIAL PROGRESS.

An Appreciation of the Work of the Chemist by the
Minister of Trade and Commerce—What
Civilization Owes to Chemistry.

By RIGHT HON. SIR GEORGE FOSTER, P.C., K.C.M.G.

RIGHT HON. SIR GEORGE FOSTER, having been introduced by the Chairman, Dr. Shutt, spoke as follows:

Dr. Shutt, Ladies and Gentlemen,—The Chairman was very wise in not committing himself to any statement of the lines I may follow in speaking to you this evening. He was wise, also, in taking his pleasure, and trying to persuade you to take your pleasure, by way of anticipation before anything had been said. I advise you to follow his example and suggestion.

I do not know why I am here to-night. I hope that I am not here under false pretences. I can bear testimony to one thing that Dr. Shutt said, and that was in regard to the pertinacity and confirmed obstinacy of your Secretary, who, once he started out on the quest, never let up until I had to give in. There is one valuable quality that you have—and by the way, he comes somewhat under the wing of my department. In fact, I was quite surprised to know what a large part I was of this Society. In matters of high-grade research, in the way of pure science or applied science, my department has been instrumental in providing you with the *fons et origo*. We have an advisory scientific committee, the head of which is Dr. Macallum, who has graced us with his presence here to-night. So there you have a mentor, advisor, guide, analyst and synthesist, all in one.

Then, to my right there is another gentleman who did at one time, at any rate, come under the wing of my department (Dr. McGill). I do not know what happened him; he keeps his old quarters—he knows when he is well off in that respect—but he now gives his allegiance to another Minister rather than to myself. Still, in a certain way, he belongs to my department. And when you want to look at your films my department has the facilities for your doing so, having arranged, at some expense and with some trouble, a meeting-place where your films may be

shown and where you can enjoy them. It seems to me, therefore, that I have a larger connection with your Society than I supposed before I came here. I assure you that the knowledge thus gained has quite compensated me for my coming out.

I do not know what in the world I can say to a practical, critical audience such as that which I have before me—you who are never satisfied with theories; who are always digging into the reasons and causes of things; pulling things apart and then trying to put them together again, nature having put them together in the first instance—in the process gleaned as much knowledge as you can as to how the wheels go round and of what the cogs are made. I cannot give you any advice. I cannot lead you along any lines of theories. I cannot analyze any of these things that you call atoms or electrons—if you can analyze an electron; I am not quite sure about that. I cannot do anything of that kind; I appear before you, therefore, in a sort of helpless condition as far as any practical knowledge or advice is concerned. And yet I have always had something to do with chemistry—that is, since my early youth. The first symbolization of chemical action that I came in contact with was when, as a very small boy, I nearly blew my fingers off with a thundering, great big fire-cracker that had come into my possession. I suppose the chemists of that time had something to do with the concoction of that infernal stuff which came pretty nearly landing me out into life with a maimed thumb and forefinger.

Developing an Appreciation of Chemistry.

Then, I had a good deal to do with the early chemists of my boyhood days through the reading of ancient history, by means of which I got well acquainted with the old diviners and sorcerers and necromancers of dim and distant days. In my extreme youthfulness I enjoyed the tales of their wonderful divinations and performances. But there was always a mysterious and somewhat fearful side to that; I was never sure that in following them I was not in danger of going to the devil; it seemed to me that the father of all their secret machinations was the deity at whose shrine they worshipped and from whom they probably derived their arts and their powers of deceiving, frightening or killing people, as the case might be.

I remember reading after that, along in the course of history, of the alchemists, that wonderful set of men who were always striving for two things. One of these was to find out the elixir of life; to make it a practical thing for youth never to grow old and old age never to cause the serious accident of a departure from this world's existence. They were after the elixir of life—and the world would have been an awfully sorry world if ever they had found it and all of us were condemned to live forever on this sub-plane of existence. Then, they were after the philosopher's stone—the thing which, if I remember rightly, was to turn all the base metals into gold and to make its possessor, and ultimately all people, infinitely rich. Had they been successful I suppose that we should now have no iron, no steel, no other like metals; all would have been transmuted into gold. We would, in a literal sense, have been living in the golden age, but all of us would have been starved to death long ago had that been the case.

The Chemist's Family Tree.

Following the form of the old Biblical chronicle which gives the genealogy of people, I suppose I would not be far wrong if I said that the modern chemist is the son of the alchemist, who is the son of the old diviner or soothsayer, who is the son of the evil one. That is the line of descent from which you have come. Well, don't be discouraged by that. A great many philosophers have made us all out to be descendants of the monkey. Of the two I am not sure that I would not rather take the superior intelligence as an ancestor, even if he was a rather bad one.

Now, having given you your descent in the genealogical line, let me express the hope that you have abandoned the secrecy and the wickedness of the old diviner and necromancer; that you have abandoned the wild ideas and over optimism of the alchemists and that you have settled down at last on the plane of pure truth and scientific knowledge and their practical application. After all, however, I am not sure that all these classes that I have mentioned and all the intermediate classes which came between them did not, in their search for certain things that they never found, turn up a great many things which subsequently became useful to the world. They turned over the soil, did the first exploration, made the surface trenching which has resulted in bringing about an age of

analysis, of examination, of scientific testing; an age of getting at the deep-laid laws of nature and the ingredients and formations of substances, their qualities and their processes, and the manner in which these can be put to the best practical use. Whatever pursuit a man may earnestly engage in, however wild it may be in theory, he may either take up himself or reveal to others who are by his side some things which are of great benefit; some things which are like seeds that afterwards bring about a bountiful harvest of the better and the more practical and the more scientific.

Chemistry in Modern Agriculture.

Take, for instance, agriculture, the old, primal industry of the world. For thousands of years the farmer has farmed and the world has lived through his farming. During the most of those years the farmer used material, the laws and properties and qualities and tendencies of which he had no scientific knowledge whatever. He planted as his fathers planted. If he was as good a man as or a better man than his father, he observed things during his planting and effected improvements according to his observations. His observations, however, were only those of sight, of touch, of the senses. Yet he farmed, and the world lived. I suppose it is not much more than half a century ago that science was first applied to the farming industry and became its helper and subsidiary. Within the short time that has since elapsed, observe how everything has improved, how everything has speeded, how everything has gone ahead, until to-day the intelligent farmer is on the high road to the greatest success in his profession. Over the things with which the farmer had been dealing from the earliest period without knowing their qualities or being able to direct their tendencies, he now has full mastery because of the application of this scientific knowledge. Farming owes, and in the future will owe, the greatest part of its success to this released, helping force which has been brought to the hand of the agriculturist—this scientific knowledge deduced by patient examination, testing, analysis and synthesis. So that the oldest of the professions or occupations of the world, linked up, as it has been, with this new helpmeet and subsidiary, has before it in the future the achievement of its greatest conquests and its greatest progress.

Chemistry Basic to Progress of Civilization.

In these later years particularly, chemistry has revolutionized industrial processes and industrial methods. We have passed through the age of stone and through the age of iron, but it is only lately that we have come to the real iron and steel age, in which improved processes and methods have brought about amazing development in connection with the industrial enterprises which are engaged in production of various kinds. And we do not know where we are now. Out of iron comes steel, and steel processes which twenty years ago men did not dream of are now in active operation, developing the metalliferous resources of the world. Since earliest times we have been treading on banks of clay, but only within recent years have we come to find out the uses to which aluminium, for instance, can be put. We are now looking forward to an age in which aluminium will, in a great many things, take the place of steel and in which its different qualities will make a revolution in the manufacture of things necessary to the comfort and progress of the world. Here we get an idea of what chemistry has done so far as industrial processes are concerned. Of course, this is not news to any of you; I am simply trying to make a little sketch the application of which I shall bring out later.

Chemistry, however, has done more than link itself up with agriculture and with industrial processes. Chemistry has done things for the benefit of what is other than material. How many of the safeguards and comforts of life, which we enjoy to-day but which were unknown to our forefathers, are available to us because chemistry has done its work; has found out certain laws, processes, antidotes, alleviations—whatever you may call them. What an effect chemistry has had upon conditions in respect to pests, pestilent breeding places, alleviation of pain, processes of medicine and of surgery, the devising of antidotes, the working out of counteracting agencies to others of a harmful nature. Take, for instance, that prodigy of work, the building of the Panama Canal. Repeatedly this enterprise was undertaken, but always nature was too strong for the efforts of man. But at last that tremendous work was completed, and the achievement was made possible because of the purification of the isthmus from the deadly poisons and the unhealthy surroundings which rendered it almost

impossible for human life to bear the strain of long continued work. That shows what can be accomplished by the patient analysis, the careful examination and the thorough testing incidental to chemical work so far as concerns the purification of atmosphere and of surroundings which are deadly or dangerous to human life. The city of Havana is another instance of that kind; but there are instances everywhere.

Perhaps it is because people are busier than they used to be, but it is true that we seem to forget—we cannot keep in mind—all the things that have been accomplished in this line. Every once in a while we come up against something in connection with which we remember that in such and such a year there was an intimation or announcement of that, but it had gone out of our minds. But the work has gone on, spreading its life-saving and healing power every year throughout many countries. When we come to reflect upon the matter and to look into it—may be with the aid of a good library—we are amazed at the improvements which have been effected and which have received their impetus from the work of the patient analyst and investigator, out of whose activities have come these practical applications which have added not only to the health and comfort of the people, but also to the lifetime of the world. So that individually, socially, from a community and a national point of view, chemistry has bestowed a great benefit upon the human race. You may sum up the progress that has thus been made; you can see what the world owes to those patient, unostentatious people who have been working in laboratories day and night, unknown to the community generally, scoffed at by the practical man, sneered at by the man who is enjoying life, looked upon as hermits digging into impossibilities. But these men have been justified to this generation and will be justified to posterity. Out of their quiet, tireless work there have come great blessings to humanity.

New Sources of Power.

The world has an odd way of surprising us every once in a while. When one of our resources shows signs of being well worked out, there suddenly looms up into sight from this very same category of work a property or a resource of which we had known nothing before. As one thing begins to show signs of diminution, something else

is brought out; and the world to-day is just about as rich in comparison with what is hereafter to be developed as it is in comparison with the days of two or three thousand years ago. The patient digger has yet incentives to carry on his work. The age that is directly before us is, to my mind, to be more prolific, more productive of remarkable developments, than is the age which has preceded it—perhaps than any age which has come before—to this army of chemists, of patient analyzers who investigate the qualities of things, the laws that govern them and the combinations and effects that may result from them.

Results of Business Divorced From Nationality.

We have just gone through a war. That war has been, as we all know, the most terrible, in all its aspects, of any war that the world has seen. We owe it no gratitude for the men it has slain, for those whom it has robbed of their loved ones; for the diseases it has engendered, for the poverty it has brought about, for the long line of horrible consequences which will follow it through this generation and the next generation and many generations yet to come. We hate it for all that; but once in a while we can extract a sunbeam from the cucumber and we can find some compensation even amidst all the horrible debris left by the war. War showed us that we had divorced business from nationality. Now, my theory is that business should not be divorced from nationality. It is all very well to say that a commercial man in the British Empire should think only of himself and of his gains; that he should care not a continental for anything else; that he should make as much, sell as much and profit as much as he possibly can, with supreme disregard of the nationality which has given him his home, which protects him and his children and his children's children. True, the commercial man has an absolute right to carry on his business, conduct his processes, make his sales and receive his profits within all reasonable and proper bounds. But he owes a fealty to the nation which protects him and within the borders of which he carries on his activities. Before the war a commercial man would say to you: "Yes, we discovered some processes in Great Britain; but realizing that the German is a man of infinite patience and detail, we let him take those processes, and after he perfects them and acquires a monopoly of them, we buy them from him, making money in some other way to pay for what we

receive." So some of the most valuable inventions and processes which were discovered in Great Britain went over to Germany, under that commercialized idea of business. But subsequently there was trouble. The national boundaries became things which you could not cross with your dollars and your roubles and your other money significations. Then it was that the Empire found that that idea of nationalized commercialism was likely to wreck it. Germany had the monopoly in respect of things that were vital and necessary to the defence of Great Britain in time of war, and years were added to the war, hundreds of thousands to the dead, and billions of dollars to the national expenditures, because we had forgotten that the commercial man within the nation owed something to the nation itself. What he owed in this case was to see to it that these vital processes—vital to the nation's existence and to the development of its resources—were kept within the borders of his own land. Well, we have learned the lesson—and it was a bitter lesson to learn. But I do not think that the lesson will be unlearned; and that is something that the war has given us.

But it gave us something besides that. When I was over in England one of the British Ministers told me that when the first army that Britain sent over to France came to be overhauled and equipped, it was found that one of the articles used in that equipment was controlled by a monopoly in the hands of Germany and that in not a single factory in Great Britain could that article be made. Well, that was a startling lesson. What I mean to say is this: that our weakness and our bad policy was shown to us by the war. But the moment that came to be understood, the British people set themselves to work and replaced, so far as they could, what had been lost to the enemy in that respect. But, as I have said, what precious time was lost and what precious lives were sacrificed before what had been lost was regained. The resources, the skill, the inventive genius of the British people under the stress of war equalled and surpassed anything of that kind that had been seen in the German Empire. We learned the fallacy of what we had been teaching ourselves for many years—that the Germans were superior to the British people in this, that and the other thing. The fact of the matter is that they were not; they were simply

allowed to get possession of these things and build up monopolies in them. But the resource, the skill, the inventive genius of the British people developed during the period of war; so that we have not only been shown our weakness; we have also been impressed by the fact that we have within the Empire resources and genius and skill equal to those found in any other country of the world. So that these lessons we may apply to the peace conditions which have followed the war. We shall be very foolish and silly people if we ever unlearn them or ever forget to put them to their proper uses.

The war has entailed upon us tremendous expenditures and very heavy burdens. We have splendidly gone through six loans in Canada, but we are not at the end of our burdens, by any means. The hard days are all ahead of us; we might just as well make up our minds to that now. The hard days are not behind us, except in the fact that we hope there will not be much more blood-letting. We must renew the waste, the incalculable waste that has resulted from the war—waste not only of material, but of human fibre. Millions of the strongest and best of the races have been left *hors de combat*—completely disabled, partly disabled, maimed, confused in mind and body. I tell you that no pen can truly depict the awful degradation of power, physical, moral and mental, that the war has brought about. It is not too much to say that the world has been set back a good many years in that respect—how many years may depend upon the amount of thought that we give to the matter.

Produce and Save.

You hear the slogan everywhere, "Produce and Save." Produce, that is, not only what you need for yourself, but produce to sell; because if we do not produce to sell to people outside our own country how are we going to adjust the balance of trade? How get our exchanges into shape? How pay our debts and our obligations? We must produce, therefore, not only for the eight millions of Canada, but also for eight millions outside of Canada, so that our surplus products will be the means of bringing money from abroad, enabling us to meet our obligations and maintain a proper balance of trade and international commercial exchange.

Then, there is that which is almost, though not quite as important as production—saving. By doing without any-

thing that is not fairly necessary for good living and saving all the rest, thus enabling the shipment of that surplus to other countries for the purposes which I have explained, we go a long way towards accomplishing the very necessary work of reconstruction. These two essentials must, then, be conjoined together—save, and produce.

The Waste in Canada.

Now, the lesson we should add to that is simply this. With the exception of the United States, which is a wasteful country, too, Canada is probably one of the most wasteful countries in the world. Our people have been so few in comparison with our vast extent of territory and great resources that the idea of saving has never distilled itself in the heart and mind of Canada. We have had forests innumerable. If a piece of timber was wanted a fine tree would be taken out of the forest, the required piece of timber obtained from it, and the rest left to rot or go to pieces. Now, that is a striking example, but that is the way we begin. I was brought up on a farm. My father had bought what was called a new farm; it was studded with rock maple, white maple, yellow birch and white birch. I will tell you what we did on that farm—and I have a very vivid recollection of it, because I piled what they called black fallow on that farm. Perhaps you who live in the city do not know what that means. Well, you go into this forest of birch and maple and you cut down ten acres of it. Your old family fireplace will take a certain amount of that for the winter's burning, and may be you will be able to sell a few cart-loads here and there. As a rule, however, other people have just as much as you have and there are not many to buy; market conditions then were not what they are now. The remainder that you cannot use is piled up in large heaps, left there through the winter, gets the spring and summer suns upon it, and during the summer the whole thing is set fire to and burned off—brush, wood, everything. What remains after the fire has raged through the heaps is as black as the ace of spades. Piling black fallow means going into that and piling it up with your hands into sub-heaps, and then setting fire to those. You go out in the morning well washed and clean; you come back looking like a man who has been through a soot bin.

Well, there is an example of the waste that has gone on

in our country. Some of the waste could not, in those early days, have been avoided; but the same spirit of waste has gone on through the whole of the forest production of this country. How much of the lumber that is felled is left where it falls and allowed to go to waste? Now, this is where chemistry comes in. Material in connection with our great industries—timber, coal, fisheries—is rotting in our fields and forests, running to our rivers, burned up by the fires; and with the assistance of the chemist much of this material can be put to good use. There is one great field that is open to us. Necessity will compel us to husband our resources, if only for the mere sake of commercialism itself. But again I say that there is something higher than mere commercialism. After all who are now living on this earth pass away another generation will require resources to live upon; therefore you are a conscienceless man, you are a thoughtless man, you are a heartless man if for the sake of making profit you care not whether you take the last fish that is in the lake, the last tree that is in the forest, the last piece of coal that is in the mine. You must remember that people are to come after you; that such control must be exercised and such methods adopted as will ensure to future generations a chance to exist within the bounds of our country. And by the conservation of the old things and the finding out and proper application of the new, you can make it pretty sure that no matter what the population of this country may be in the future there will always be ample for its subsistence.

There are certain things which, if exhausted, cannot be replaced. You cannot make coal again; it requires too much time. It is like the soldier who wants his gratuity now; he doesn't want to wait for it until later. It is like the civil servant who wants his bonus now, at Christmas time, and cannot afford to wait. It is like you, Mr. Chairman, who want the reclassification right, and that now. But I say that there are some things which you cannot replace, and coal is one. Coal can be conserved, and used as a national asset as well. But that is the extreme case; there are other things that do not perish in the use thereof. Take agriculture. The lands of this country should become richer the more they are tilled. For instance, you export one hundred million bushels of wheat.

You send that away to Europe, and you get a good price for it. You have completed your transaction; have you transported anything except grain? Now, there is a question to answer. You have exported some of the vital foods of the land upon which that grain was raised; and if you go on exporting similarly year after year, you will have to turn round by and by and purchase back at great cost fertilizers to replace that food value that you exported. And when you figure it on a basis of fifty years, you will find that your exporting has not been as profitable as you might have thought. However, the point I wish to make is this: agriculture can be so carried on that the land will become richer year by year. With all our scientific and experimental knowledge, this country ought to see to it that the lands of Canada shall not become a failing asset, but that they shall rather become a constantly growing asset so far as fertility and power to reproduce is concerned. There chemistry comes in and performs its work. As this scientific knowledge filters into the minds of the farmers and of the people generally, the benefits will become apparent and the soils that are cultivated will have increased fertility and productiveness. This, then, is one of the resources that you can keep.

Take your fisheries. Why should you not have an interest upon capital in the way of fisheries and not allow that capital to be diminished? You can do it by employing proper methods of fishing and by utilizing everything that you take out of the sea in the way of subsidiary products. You will have a greater yearly output, and by carefully observing the proper methods of fishing and looking also to reproduction, your fisheries will not diminish with increase of population, but will be sufficient for all purposes and will at the same time afford an interest upon your preserved capital for foreign account. So that you can divide our resources into these two classes: those which are perishable, and those which may be maintained always if we deal with them in the right way.

There never was a golden age for the chemist and the scientist comparable to this, so far as the application of these truths to agricultural pursuits is concerned. And when I use the word "agriculture," I include stock as well, the very same thing is true of stock. All of you who are around these tables know what improvements

have been made in the feeding and breeding of stock and all that pertains thereto by the employment of scientific methods, thus improving the standards, increasing the production, and enhancing the value of one of the world's great resources.

My time is up and my car is waiting. That is all I am going to say to you to-night.

Ottawa, Dec. 18, 1919.