can be used to advantage. It is also made by the action of steam on red-hot iron and by the water-gas reaction wherein steam reacting with coke produces approximately equal volumes of carbon monoxide and hydrogen. By further reaction with steam in the presence of a catalyst, as shown by the following equation,

most of the carbon monoxide may be removed with the formation of an equal volume of hydrogen, but a long and elaborate purification process must be followed to bring the gas to a pure and dry state. The refinement of purity necessary will vary with the different catalysts, but the impurities must certainly be measured only in hundredths of a per cent, if not thousandths. Further research work on the purification of hydrogen is desirable.

FUTURE OF NITROGEN FIXATION PROCESSES

The future of the nitrogen fixation industry can be forecasted only in the most general manner. It depends upon two factors, the demand for fixed nitrogen and its price. These two factors are in part independent and in part linked together, for a lowered price is certain to cause a greater demand. The principal demand of the last few years has been for munitions, and the demand was an insistent one which had to be met regardless of price. The great normal demand for fertilizers has been restricted to a minimum. The largest demand for fixed nitrogen in the future will probably be for fertilizers, and the use of fertilizers will be very largely a matter of price. The diagram, Fig. 1, shows an increase of roughly fifty per cent in output for fixed nitrogen for each four-year period. It is not probable that 1921 will show such a proportionate increase although if all the resources of Chile and all of the facilities in the way of coke ovens now under construction, and fixation plants should be utilized, the year 1920 might well see a possible production of 25 per cent more than 1917. What will be the cost of production? The cheapest source of fixed inorganic nitrogen will undoubtedly be the ammonia from by-product coke ovens because it is a by-product and the cost of collecting and putting it into marketable form is small. The coke ovens of the world can now produce more fixed nitrogen than the world used from all sources ten years ago. It will be a powerful factor tending towards low prices. It is probable that Chilean nitrate could, if necessary, be sold at lower prices than in former years. The fixation processes will therefore have to be prepared to meet possible low prices if they are to be ranked as anything more than emergency reliances.

The cost of nitrogen in the staple raw materials sodium nitrate and ammonium sulfate varied from \$12 to \$16 per hundred pounds in the years 1900-1915. It is manifest that a process which is to produce a large proportion of the world's fixed nitrogen must be able to compete with these staple materials. Smaller factories may produce specialized products such as sodium nitrite and anhydrous ammonia for which there is a demand, large in itself, but small in proportion to the world's total demand.

The necessity and the possibility of independence of Chilean nitrate as a material for munitions has been proved in the past four years. The question as to whether the fixation processes can compete with Chilean nitrate and coke oven ammonia in times of peace, and for the cheapest commercial nitrogenous product—fertilizer—cannot yet be answered.

The cyanamide and arc processes both labor under the handicap of the requirement of large amounts of electrical power. The nitride process has a somewhat similar handicap but possesses a possible advantage in the recovery of alumina as a by-product. The cyanide process labors at present under the disadvantage of small manufacturing units but has the advantage of low-power requirements and the possible recovery of formates as by-products. The direct synthetic ammonia process presents

great engineering and chemical difficulties, but has great possibilities of future development. As will be seen from the table earlier in this paper, if an inventor could find a catalyst active at 300° C., he would have the theoretical possibility of increasing the conversion by one passage through the apparatus at 100 atmospheres pressure to fivefold the conversion at 500° C. Or with such a catalyst, he could work at 30 atmospheres pressure and 300° temperature, eliminating thereby many of the serious engineering difficulties and still obtaining a conversion far better than anything now commercially known to us. There is no theoretical reason why such a catalyst might not be made, and its discovery would offer the possibility of cheaper fixed nitrogen than anything heretofore known.

RESEARCH TECHNICAL DIVISION
NITRATE DIVISION, ORDNANCE DEPARTMENT
WASHINGTON, D. C.

THE NEEDS OF THE U. S. PATENT OFFICE¹

By THOMAS EWING, Former Commissioner of Patents

I believe that one result of this war is going to be that there must be new methods of business introduced, and that the competition for business all over the world will be keener than it has ever been.

All great manufacturing establishments are keenly interested in original and novel developments in their particular lines. I happen to know that the General Electric Company, as one of its activities, maintains a large and superbly kept laboratory of research, and the expenses which are incurred for it are not treated as strictly commercial, but are expected, in a large way, to pay themselves many times over. I have no connection with the General Electric Company in any capacity. I once sold some patents to another great company, the Bell Telephone Company, with which also I have no connection. They paid half a million dollars for them, and before they had a single dollar of return, they had spent one million dollars more in determining the exact conditions of the economical use of the inventions. But there has never been a time since they acquired them, when they could have been bought back from them for ten times what they paid for them. I think it is true of all great enterprises, that if they are not handled in a broad way—I do not care how large the company may be, or how large its business may be—dry rot will set in, competitors with new ideas will enter the field, and they will find the ground cut from under them before they know it. Therefore, all great concerns are interested in original development, and that means that they are interested in patents, or should be; and it also means that it should be a regularly recognized line of development which must be liberally treated, both in acquisition of inventions from the outside and in developments within the company.

I know that everybody who has anything to do with the patent system complains about it, and there is reason for complaint, but the complexity of the questions and the vast field which the patent system covers make it impossible that all of the troubles should be either removed or immediately mitigated.

There is one factor in our patent system which everybody should be interested in and should try to help, without any regard whatsoever to one's general opinion about what the patent system should be, or what it is worth; and that factor is the Patent Office.

We could have a system of registration of patents such as we did have down in 1836, and such as a number of countries have to-day, but in 1836 this Government introduced the system of granting patents on examination—examination not only of the form of the papers, but of the invention, as its novelty; and from that period on, the Patent Office has been an important and constantly growing factor in our system.

¹ Address before the War Emergency Reconstruction Conference held at Atlantic City, December 3 to 6, 1918.

The theory of the Patent Office is that patents will be granted only when they ought to be granted, and that the claims that are allowed will be only such as ought to be allowed; and in view of the fact that there are more than four hundred men engaged constantly in the examination of applications, the courts give great weight to what the Patent Office concludes. They are frequently saying, "Why, there is a finding by the Patent Office; here is something which the experts of the Patent Office have held to be novel over the other patents which are being presented to us;" and the courts will therefore reject arguments for holding a patent invalid, or for limiting it. They rely upon what the Patent Office has decided, and seek to give effect to its conclusions. With such an attitude, which is perfectly proper in view of the theory of the Patent Office, it is the worst sort of business to have a Patent Office that is insufficiently provided with men and facilities for making proper examinations. It becomes dangerous, because weight is given to patents which is not deserved, not that the Patent Office is not industrious, and not that its *esprit de corps* is not high, for the examiners are both industrious and of high character, but because the Office is inadequately supplied with means and with men to make proper searches, and their conclusions are therefore, in many cases, erroneous.

I would like to impress upon you to-day that it is of the utmost importance to all of you, no matter whether you are interested in patenting inventions or are interested in going into new fields which are being developed by other people where you may have to meet hostile patents, it is to your interest, and it is to the interest of every inventor as well, of course, that the Office be efficiently and adequately provided with the means necessary to perform its great labor.

I was in the Patent Office for four years as Commissioner, and previous to that, thirty years ago, as an assistant examiner; and I have practiced before it. I have no personal interest in what may be done for it, or any personal pride of position in it; but it is perfectly apparent to me that the provisions for the Office are inadequate. And it became apparent to me while I was Commissioner that the Office, through the ordinary channels, is not able to influence Congress to give it proper facilities. Only influence from the outside—I mean, of course, influence that is entirely proper and legitimate, of people who are interested in having the thing done right—can bring effective pressure to bear upon Congress. Only in that way will the Office get what it needs.

Let me give you an illustration of the difficulty. The last year I was there I made a recommendation to Congress, asking for an increase in the force which would have cost one hundred thousand dollars a year. I had studied the Office diligently for the three preceding years, and I presented the reasons for the need as strongly as I possibly could. At the end of the deliberations there was not one cent allowed for the things that I asked for. Subsequently we entered the war, and many people who had applications in the Office, which were not being reached for action because we were behind, were writing, asking to have their cases made special. I could not make one man's case special without being guilty of unfair treatment to the others whose cases were awaiting action, and I adopted the method of writing to each one who asked to have his case made special that I was unable to do so, because the facilities and means provided in the Office for acting upon the applications were insufficient, and that my appeal to Congress to increase these means, which I had based particularly upon the probability that we were going into a war, and a dangerous situation might arise, had been entirely fruitless. Some of the letters which I wrote—and I wrote many—came back to the congressmen, and the congressmen went to the appropriation committee, and the committee finally sent for me and said that they would hear me over again; and after a great deal of effort, I succeeded

in getting an increase of about forty thousand dollars where I had asked for one hundred thousand.

What the Patent Office needs is not forty thousand dollars, or one hundred thousand dollars, but about one million dollars; and it is utterly impossible for the Office to get any such increase of appropriation unless some large influence is brought to bear to make Congress look into the matter and see what the situation really is.

Six hundred thousand dollars a year more than is now spent ought to be spent in increasing the examining corps and the clerical force, that is, increasing the personnel. Three hundred thousand dollars more ought to be spent in increasing salaries. The salaries are ridiculously low. The primary examiners, of whom there are forty-five, have the authority to pass out patents, sometimes of enormous value. If one of these primary examiners signs a file wrapper, the patent goes out automatically. It is true that the Commissioner must sign it, but as he has to sign about seven or eight hundred a week, it is entirely impossible for him to examine them; and, therefore, these forty-five men have it in their power to pass out patents which may be worth millions of dollars. Men who are doing work of that sort should be properly paid. The primary examiners who have that authority receive twenty-seven hundred dollars a year. A very large percentage of them are men of college education or technical school education. Most of them have gone through a law school; they are highly educated men; they are, I am happy to say, men of character. It is one of the greatest reasons for pride that we may all have that the Patent Office, the repository of secrets of great value, immense value, is practically above suspicion as to improper dealing. In the four years that I was there as Commissioner my door was open to anybody who chose to come in and complain. I never refused to see a man who called upon me the whole time I was there. I saw everyone alone. I have never had a man come to me and say there had been any improper dealings in the Office. I had letters, a few letters, saying that there was, and I investigated every instance carefully. I never found ground for belief that there was anything of the sort, and in the experience which I have had with the Office, running now over thirty years, only two cases have ever arisen, so far as I have been able to find, where any man was seriously suspected; one man was sent to the penitentiary and the other man died just before the question was brought up for decision. No man who had any disposition to use the Office improperly could live in the atmosphere there. He would be driven out by the other members of the corps. Now, men of such character, men who are serving in the Office as primary examiners—on the average the primary examiners have been in the Office for twenty-five years—devoting all their lives to that work, ought to be paid a salary which will enable them to bring up their families with the same educational advantages that they had themselves; that their place demands of them. Yet this is not possible under present conditions.

And what is true of the primary examiners is also true of the first assistant examiners, and the second assistant examiners. The lower grades of assistant examiners are not so important. Young fellows come in and stay a few years, go through the law school, learn the ropes, and go out to practice. The third and fourth assistant examiners probably get enough, but if a man is willing to stay and make that a life work, becoming, as he does, more valuable every year, because of his knowledge of the arts that he is examining, these men ought to be paid a proper salary, not only as a matter of justice, but as a matter of wisdom.

While there are some men of very fine ability in the Office, it is true that the work suffers seriously because of low salaries. And yet, if you go to Congress, as I went year after year, and ask for an increase of salaries for the primary examiners, and for the assistants, you will meet with this statement: "You

are simply trying to get more money for a lot of men who are there now." Well, I was not. I was trying to build up a great Office, or help to. It is a great Office now, but I was trying to improve it, but that is the spirit that Congress displayed. They treated it exactly as if it were any clerkship that was under discussion; and the Office cannot get by it, but men like you can; if you will give the matter sufficient thought, and make up your minds that it is right, and bring influence to bear upon Congress, the matter can be rectified.

The equipment is also insufficient. For example, there is a library of technical books and technical literature. You gentlemen all know that the technical literature of the world is very large, and constantly increasing. Congress allows three thousand dollars a year for the Patent Office to keep up with all the technical literature of all the arts. It ought to be fifty thousand dollars, and it ought to be whatever is necessary beyond that; and yet it was absolutely impossible for me to get one dollar beyond the three thousand dollars a year while I was there. There was a separate set of German patents, two hundred thousand in number, which we wished to bind by classes according to German classification, so that searches might be made through them by the public who are interested. Instead of making a list of all the patents that dealt with electrical motors, for example, and then going through twenty-one hundred volumes to get at them, we wanted to have four or five volumes of electrical motor patents, and so with the other arts. It took me three years to get an appropriation of twenty thousand dollars to bind them, and during that whole time they were tied in bundles, because we did not dare open the bundles for fear numbers would be lost.

There is another matter of great importance. These young men and these older men, the examiners, instead of being obliged to get knowledge from books only, ought to be able to go out and see what the manufacturers are doing in their establishments. They ought to learn the arts as they are actually practiced, so that their judgment would be sound. I sent out as many as I could; I would have sent all of them out from time to time to make investigations if I had been permitted to do so. I could have raised a fund of fifty thousand dollars easily by voluntary subscription from concerns that had applications pending, but sending the young men out by the use of funds raised in that way would have put the Office under obligations, and it would have placed the assistants in positions where they might be open to suspicion and criticism because they had a pleasant trip to Chicago, or St. Louis, or elsewhere; and Mr. Lane, I think properly, said he would not permit it. But here was a fund which I used for that purpose. It was five hundred dollars. There are now four hundred and nineteen in the corps; this sum was about \$1.25 apiece for these men. I tried my best to get Mr. Lane to agree to ask Congress for thirty thousand dollars for that purpose, and he said it was absolutely useless; he would not do it; he knew it would not be granted. But an appropriation like that, properly presented to their congressmen, by people who know the importance of it, might easily be secured.

I wish to speak also of the position of the Office in the governmental system. The Patent Office is a bureau of the Interior Department. When I went into office I did not know Secretary Lane. He sent for me shortly before I was appointed and I then met him for the first time. I formed an intimate friendship with him, our relations were most cordial, and I regard him as a great man, and yet, in spite of that, I am obliged to say after a four years' experience as Commissioner that the Office gains nothing by being a bureau of the Interior Department, and that it is seriously handicapped by the connection. It ought to be an independent office, answerable to nobody but the President and Congress, just as the Agricultural Bureau was before the present Department of Agriculture was created. The reason is that it is one of eight different bureaus, unrelated,

the work in one not similar to the work in another, the needs of one not similar to the needs of another. But, if an attempt is made to increase the salaries in the Patent Office, or to increase the personnel, immediately the question arises, "What about the Land Office? Won't the Commissioner of Pensions want salaries raised?" Thus a comparison is made between the Patent Office and its needs, and the needs or demands of other offices having no relation to it whatsoever. That comparison the Secretary could not fail to make, no matter how well he might understand the conditions in the offices, because he would arouse jealousy. And if he made up his mind that one office needs better salaries than the others, because it is engaged in a higher class of work, and were to pass that recommendation on to Congress, the Congress itself would make the very same comparison and he would not get anywhere.

If the Office were an independent bureau, it could fight its own battles without any such disadvantageous comparisons, and I believe that if that change were made and gentlemen such as you would interest yourselves, and get your local bureaus and your legal departments to interest themselves, in any way you may see fit, in the needs of the Office, we might get the necessary assistance from Congress, and we could build the Office up to the point where it would be, in fact as it should be, the most superb patent office in the world—and its judgments would be far more certain and trustworthy. I think such action would save every year, in the relief of business from the uncertainty of wrongly granted patents, millions of dollars over all that it would cost.

It is constantly said, when the subject of increased appropriations for the Patent Office is raised, that the Office pays its own way. In the last five years it has turned back into the Treasury about one million dollars over the entire appropriation for it, and the building which it occupies was largely built out of surplus which had accumulated in the Treasury from Patent Office fees. But there is no reason why public money should be wasted, no matter where it is drawn from, and the income of the Office is not the measure of its needs, nor of the service it renders to the public. If the Office must be kept self-sustaining, it is an easy matter to increase the fees for patents, and I think that the business interests of the country would stand it. I do not think that is important. The important thing is that the needs of the Office should be intelligently studied by Congress, and when ascertained they should be provided for, without any regard to whether the Office costs one million dollars over what it receives in fees or not.

As I have said, the Office is absolutely unable to help itself. Anybody who as Commissioner starts in to get something for the Office is immediately accused of trying to get something for himself. But intelligent bodies, and influential bodies such as this, can influence and should influence Congress. Here is a field for constructive work, where the results will be to the interest and advantage of all of us. I trust that you will make it a matter of serious thought and concerted action. I thank you very much for the opportunity to bring the subject to your attention.

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THE PHARMACEUTICAL CHEMIST AND THE SCOPE OF HIS WORK¹

By FRANK O. TAYLOR

Each of us is prone to magnify the importance of that particular branch of chemistry in which he is actively engaged, so perhaps I may be pardoned for what, to many of you, may seem a biased and erroneous opinion, or evidence of a dense ignorance concerning other fields of chemical endeavor, when I say that I believe no field of chemistry is of greater scope or more varied character than that of pharmaceutical chemistry. And

¹ Address before the Detroit Section of the American Chemical Society, January 16, 1919.