about one or two millimeters in diameter. The glass rod *A* should be selected so as to slide closely but smoothly inside of the T-tube. It must then be rounded at one end, *B*, flattened at the other end, and bent as illustrated. The nick *K* is put in with a file, and is to keep the wire spring from slipping off. Now take a little moist emery flour and grind the rounded end of the rod against the partly closed and thickened tube at *B*, so as to make a tight joint. When this is done the rest of the apparatus is quickly assembled as illustrated by closing the joints at *D*, *D* by means of the heavy-walled black rubber tubing, attaching the spring *E* (made by winding a piece of small wire around a pencil), connecting to the siphon *G*, and inserting in the burette by use of the rubber stopper *F*. (For our purposes this stopper has a small groove to allow

sides of the T-tube and out through the opening *H*, thus filling the burette. When the upward pressure of the thumb is released, the spring pulls the rod down and closes the orifice *H*.

If the siphon tube and the apparatus are dry and connected up as described, the rubber tubing will be protected from the liquid by the air caught above the joint at *T*, in the vertical part of the T-tube, and by the air space where the siphon *G* runs into the side-arm of the T-tube. The latter condition is aided by bending the side-arm slightly upward.

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OMAHA, NEBRASKA

CARBON DIOXIDE ABSORPTION APPARATUS

By L. G. WESSON

Received November 11, 1916

While engaged, about three years ago, at the Bureau of Standards, Washington, D. C., on research work which involved the making of a considerable number of organic combustions, the writer designed and used the form of apparatus first mentioned in the report on that work,¹ and now more fully described.

A cylindrical bulb of thin glass contains the carbon dioxide absorbing agent (soda-lime). Connected with the lower part by a short, thick-walled capillary tube, is the smaller arm which contains the drying agent (calcium chloride, alumina,² or phosphorus pentoxide). The capillary serves to separate the moist soda-lime from the calcium chloride. This form combines lightness and simplicity of construction with a good absorbing capacity and ease of refilling. The stopcock surface and weight are small, as may be judged from the sketch. Empty, the apparatus (about 8 to 10 cm. high) weighs 20 to 25 g.; it will hold 35 g. of soda-lime and 7 g. of calcium chloride, and will absorb 10 g. or more of carbon dioxide without renewal.

the passage of air, but the insertion of a small guard tube would improve it.)

By a slight pressure on the flattened end of the glass rod, the solution passes between the rod and the

CASE SCHOOL OF APPLIED SCIENCE
CLEVELAND, OHIO

¹ THIS JOURNAL, 6 (1914), 459.

² Prepared according to Johnson, *J. Am. Chem. Soc.*, 34 (1912), 911.

ADDRESSES

THE GERMAN ALARM CLOCK¹

By H. E. Howe

Although I have been living but a short distance out of the country for the last few months, it has given me a chance to see ourselves as others see us, and there is a temptation to make a few comments along that line. Also having been in a country seriously at war there is an impulse, upon finding a body of men gathered together, to launch upon a recruiting speech. This would not necessarily be contrary to law and neutrality, for I

¹ Address before the Rochester Section of the A. C. S., November 6, 1916.

have been reliably informed that it was recently necessary to take the crews from three smaller vessels in order to man a new United States dreadnought, which after such an extraordinary effort still lacked 169 men to give her a full complement. So we might even do some recruiting for the U. S. A.

I even thought of bringing a collection of war relics and making that the basis of the evening's remarks, but thought better of it when I realized that at best it would be difficult to approach the expectations of the Section in the way of a scientific address, and besides, the President has besought us not to discuss the war. Nevertheless, in choosing the subject announced, I have

definitely in mind using conditions growing out of the war as a basis of what I shall try to say.

Prior to August, 1914, Germany was making a quiet, energetic and successful conquest of the industrial world. Her agents were to be found everywhere, learning the language of the country in which they worked, overrunning these countries with representatives, agents and travelers, and placing the German employees in high and low positions all over the country, in industrial and commercial concerns. Market and trade conditions were carefully studied, and unfortunately fair means of competition were not always used. Through the coöperation which existed between the government, manufacturers and banks, the German salesmen were often able to offer terms of credit quite impossible with a manufacturer not having such beneficent coöperation.

This is particularly shown in South America, where goods were often placed upon the merchants' shelves to be paid for after they had been sold to the consumer, while instances of credit up to two years are by no means uncommon.

The stocks of merchants were frequently kept filled so that competition was largely prevented. Since the beginning of the war, agents in various lines traveling in South America have found dealers to have been loaded up previous to August, 1914, with sufficient merchandise to care for their customers until 1917.

Reports from all over the world were received in Germany, and this information gathered by members of the diplomatic corps, by travelers and others, and put into such shape to allow the commercial conquest to go forward under the best possible conditions.

At home great attention was paid to research experiments and efforts to utilize all by-products, and much of the work accomplished would have been impossible without government aid in the form of subsidies and direct contribution, and the great advantage derived from the assistance of the banks, upon whose boards were technical men with voting power.

GERMAN CONTROL OF BASE METAL INDUSTRY

It may not be generally known to what extent Germany had succeeded in controlling the base metal industry of the world. This was particularly felt in Australia, where lead, zinc and copper were in the hands of powerful German trusts. It is not too much to say the German world control over lead, zinc, and copper was well-nigh complete, and affected not only the producer and the consumers in Britain and elsewhere but fixed the world's price for these commodities, limiting the output where necessary and directly controlling and affecting employment and wages.

In certain instances the refining of concentrates and matte was carried on in Germany in order that such refining processes might be kept as secret as possible, and to prevent their establishment in other parts of the world.

German workmen have not been slow to seize upon the advantages offered through the inventions of others, and in many instances have forged to the lead by effecting refinements and improvements in the inventions of other countries. Examples of this are the machine gun, the aeroplane and the submarine. Another notable example is the fixation of atmospheric nitrogen by means of which a final day of reckoning is being postponed, and the first commercial process for fixation was developed by two Americans.

When the woeful mistake was made of starting the present war, it soon began to be demonstrated that by turning the same forces to account, as had been used in commercial conflict, Germany could very nearly carry on a successful conquest of Europe. Many problems had been worked out in advance, and real research work had been employed to develop totally new weapons for offense and defense. The ex-

tent to which chemists were depended upon is well illustrated by the nitrate question. I have been reliably informed that it was not expected that all nitrate would be excluded from Germany, but that quantities could be imported by way of Italy, it being thought that that country would not enter the war. When it was found that a miscalculation had been made, orders were issued to the various organizations of chemists that they simply had to find ways of providing sufficient nitrates. This has been accomplished, and I have no doubt that after the war we will learn of greatly improved processes for the fixation of atmospheric nitrogen.

Now all of this state of progression is by no means due to any real superiority. Germany is comparatively poor in natural resources, having a corner on potash only. The proper conservation and able husbanding of such natural resources as Germany possessed, has contributed most to their advantage, while the perseverance, patience, industry and economy, which are racial traits, deserve their full amount of credit. There is no corner on brains or inventive genius, but there is in Germany an appreciation of education, concerted effort and research, which to my mind have been the cardinal points in such successful conquests as have been waged.

There is a smaller percentage of illiterates in Germany than in any other country on earth. Of the population in the various countries the following is the percentage of illiterates:

Roumania.....	88.4	U. S. A. (whites).....	6.2
Servia.....	79.3	France.....	4.7
Portugal.....	79.2	England.....	3.0
Spain.....	68.1	Scotland.....	2.5
Russia.....	61.7	Holland.....	2.3
Hungary.....	47.8	Finland.....	0.5
Austria.....	35.6	Denmark.....	0.2
Italy.....	32.9	Switzerland.....	0.13
Greece.....	30.0	Sweden and Norway.....	0.08
Belgium.....	10.0	Germany.....	0.05
Ireland.....	7.9		

In some German provinces, such as Saxony, one is said to rarely meet a person who cannot read or write.

In considering the percentage in the United States, it must be remembered that the population is a mixed one and contains large numbers of whites from those countries which have a large percentage of illiterates.

In the armies there are said to be the following number of illiterates per thousand:

Russian.....	700	Austrian.....	250
French.....	50	German.....	3

It must be remembered that the British army is a voluntary one and of such recent growth that no reliable figures are obtainable. Since the best men usually volunteer first, the percentage of illiterates may be expected to increase as the volunteer army grows large.

I regret that no figures were obtainable on the Turkish, Belgian, Servian or other minor armies. While I believe that much of the German education must have been faulty to have permitted the present state of affairs, yet it is worth noting to what extent education has been appreciated.

The German accomplishments through research are already so well known to you that I need take no time in emphasizing what has been done.

ACTIVITIES ON OPENING OF WAR

To this state of affairs came August, 1914, and we find an entirely new order of things. As soon as Germany is blockaded and her merchant fleet swept from the seas, countries have awakened, as if by an alarm clock, to the extent of their dependence upon German products. A careful study of the causes leading to German predominance in various fields has led others to offer sincere compliment by imitation, and by taking a leaf from the German book. Research is evidently one of the things upon which German progress has been based, coöperation is

another, and the war has awakened the rest of the world to the desirability of employing the same methods.

A committee of the Privy Council of Great Britain, to consider scientific and industrial research, was appointed, and their report for the year 1915-16 is of great interest. A series of pamphlets are to be issued on various subjects pertaining to research, and one of these is to be written by your own Dr. Mees.

The National Physical Laboratory of Great Britain, encouraged by the Government, has undertaken an exhaustive study of optical glass manufacture, and Dr. Rosenhain's Cantor lectures on this subject indicate that real progress is being made.

The effort toward the establishment of a British dye industry is well known to you, while the progress which has been made in perfecting mechanical operations is little short of marvelous. Improvements in grinding and polishing machinery, which are said to have been made in the works of Adam Hilger, are sure to put that firm in a better position to compete for world markets than ever before, and many machine shops, heretofore accustomed to do only rough work, will emerge from the war with a staff of men trained to work to the fraction of an inch, from ten to one hundred times smaller than had been their custom previously.

Conditions have also tended to break down some of the strict rules of the trade organizations, and this will naturally have its effect in the commercial competition which is to follow.

All over the world there is being pointed out to manufacturers and business men, that, as united effort is necessary in things military, it is also necessary in things industrial and commercial. In Japan an imperial edict is said to have been promulgated, calling upon the smaller companies in Japan to combine, in fact the benefits of properly controlled combinations seem to be recognized the world over excepting in the United States, where efforts are constantly being made to dissolve large corporations. It would seem much better to control them properly, since in many cases we would be much worse off without the improvements and advances which could be accomplished only by such organizations. To my mind German industry will meet, after the war, to a competition which she herself has been instrumental in awakening, a competition organized, alert and progressive to an even greater degree than that which she attained previous to August, 1914.

I would call your attention to the economic conference of the Allies, held in Paris, during June of this year, where recommendations were made to render the allied countries independent of enemy countries in raw materials and manufactured articles, essential to the normal development of their economic activities; to facilitate and improve the interchange of their products; to assimilate the laws governing patents and indications of origin and trade marks, and for the adoption of an identical procedure in regard to patents, trade marks, literary and artistic copyrights which have come into existence in enemy countries during the war. There was also adopted at this conference a series of recommendations intended to offset entirely much of the advantage which the Teutonic powers had obtained through methods now about to be adopted by most of the world.

In Australia there has been much accomplished toward breaking the hold which foreigners had upon the mineral resources. Where necessary parliamentary laws have been passed, and the work of constructing the whole industry on purely Australian and British foundations has been entered upon scientifically and systematically. New companies have been formed, research men brought in, including Mr. Rigg, formerly with the New Jersey Zinc Company, and a comprehensive scheme covering the whole output of Australia has been adopted.

This awakening has not been confined to nations across the sea, for we find Canada more alert to-day than ever before. A "Call to Service" has been issued by the Department of Trade

and Commerce, in an effort to bring about coöperation among the business men to an extent heretofore thought impossible. Among many committees to be appointed for real service, is one whose duty it shall be to consider industrial research and to encourage the application of science throughout the Dominion, in an effort better to utilize Canadian natural resources.

CANADIAN RESEARCH

The Royal Canadian Institute is taking steps to provide facilities for research work as applied to industry. The Canadian Manufacturers' Association, a very live organization, has an active committee which is constantly bringing before the members of the Association the desirability of employing research and the various methods by which results may be obtained.

Various Chambers of Commerce are bringing research to the attention of their communities, and the Union of Canadian Municipalities, through their official journal, will emphasize research as a part of their campaign of municipal preparedness for conditions after the war.

The Canadian Mining Institute, with which the Society of Chemical Industry is coöperating, is engaged upon a study of the mineral resources of Canada, and endeavoring to determine what can be made from raw materials within the Dominion. Lists of articles and materials produced from mineral wealth are being compared with data on the existence of raw materials in Canada, their probable market and the export possibilities, with the hope that many manufactured articles need no longer be imported.

Another evidence of the awakening is to be found in a collection of between 8,000 and 10,000 German- and Austrian-made articles now being shown in the industrial centers to indicate the sort of things which Canadian manufacturers are not making, but could and should make.

There is also a plan being considered by the Royal Society of Canada in coöperation with the Government, whereby it is proposed to form a commission which will consider the research problems that can be worked out in educational centers, and assign them to the laboratories best qualified to work upon them together with an appropriation for carrying out the work contemplated.

An effort is also being made by the Canadian Pacific Railway to assist in research and development work, through Arthur D. Little, Limited, this Company having been formed in Canada under the auspices of the railway and at the suggestion of Lord Shaughnessy, the president of the railroad. It is the purpose of this company to do what it can to assist in a better and more economic utilization of the natural resources of Canada through the application of industrial research and science; to find economic uses for existing wastes; to minimize and prevent wastes; to utilize by-products and serve existing industries. This applies to the whole of the Dominion and not to the territory served by the railroad alone.

Arthur D. Little, Limited, upon the authorization of the railroad, is about to begin a survey of the natural resources of Canada, for the purpose of having together in one place, and in a form readily at hand, reasonably complete data on as many of the Dominion natural resources as possible.

Let us consider for a moment what this awakening of Canada by the German alarm clock means. There has arisen a desire to be as self-contained as possible, and to do whatever is necessary to place the British Empire in the same position. A great effort will be made to secure a large portion of the world markets, and already an export commission, with agents in various parts of the world, is bringing to new markets the story of Canadian-made articles. It has been said that the 19th Century belonged to the United States but the 20th Century belongs to Canada, and an appreciation of the natural resources of Canada would indicate that such might, in a measure, be the case.

CANADIAN RESOURCES

The most important natural resources of Canada are agriculture, timber, minerals, fisheries, fur-bearing animals, and water power. Canada has an area of 3,730,000 square miles, which is greater than that of the United States, including Alaska, and but a little less than that of Europe.

It is a country of great resources, in a position to benefit by the errors which have been made in older countries, and well situated between populous countries in the east, the west and the south. So far as construction is concerned, Canada is to-day in about the same position as was the United States a generation or two ago.

Agriculture must always be the greatest natural resource, and in 1913 the products produced were worth nearly \$700,000,000. To some of you chemists the idea of agriculture brings to mind a tall figure, straw hat, top boots and long whiskers, but you may be interested to know that many of the Western Canadian farmers can afford to spend their winters in California and Florida; that this year one field of 115 acres, in Alberta, brought in over \$10,000,000 to its owner, through the sale of wheat, and that in 1915 a single farm of 1,356 acres averaged nearly 52 bushels of wheat per acre.

Not long ago the Canadian Pacific Railway constructed a branch line of some 70 miles, and in early winter an agent visited the territory in order to pay the farmers for the right-of-way—80 per cent of those whom he sought were spending the winter in Florida or California.

While the forests of Canada are by no means as extensive as is generally supposed, nevertheless, in 1912, the last figures available, they yielded \$182,300,000 worth of products, including 1,109,034 cords of wood for pulp. There are millions of acres of wonderful woods still standing, and by adopting conservative forestry methods, the remaining timber can be made to yield millions of dollars annually, and still leave the forest, or the principal, in better condition for posterity.

The minerals of Canada yielded over \$144,000,000 in 1913, and have little more than been touched. There are vast areas in the north of Canada undoubtedly containing much mineral wealth which has never been explored or prospected.

Four-fifths of the world's supply of asbestos comes from Canada, and sells at from 75 cents to \$4.00 per ton, depending upon the length and quality of the fiber.

More than two-thirds of the world's supply of nickel has its origin in Ontario, and the greatest nickel mines in the world are located there.

Some of the other minerals include cobalt, gold, barytes, amber, mica, graphite, copper, corundum, feldspar, silver, antimony, iron, zinc, lead, molybdenite, pyrite, tungsten, titanium, palladium, and a little platinum. There are also extensive deposits of oil shales, one deposit consisting of nearly 100,000,000 tons. This shale is said to be richer than the Scotch shale, much easier mined, and consequently more profitable to distill.

In minerals, as in other resources, Canada sold the raw products prior to the war and but rarely considered the advantage to be derived from converting such material into finished products from which a greater profit can be realized. With the awakening has come a demand for concentrators and refineries. Whereas all zinc was imported in 1914 we now find a considerable quantity being refined at Trail, along with other minerals. In Ontario a large nickel refinery is being built and there has also been established a refinery to handle molybdenite.

FUEL RESOURCES OF CANADA

It is also worthy of note that the fuel resources of Canada are second only to those of the United States, so far as surveys have been carried out. There may later prove to be larger bodies on some of the other continents. However, Canada possesses large areas of peat, lignite, bituminous and anthracite coal.

There is also considerable natural gas and some oil. It should be noted, however, that the best of the coal is to be found on the Atlantic and Pacific slopes.

The fisheries of Canada are widely known, and in 1913 yielded nearly \$34,000,000 worth of fish and other marine animals. Fishing reaches such proportions during the cod season that the government maintains a daily telegraphic bait report. This is very useful, indicating as it does where bait may best be obtained on a given day.

The fur-bearing animals yielded an export trade in 1913 amounting to \$5,500,000, while there are no returns to indicate the value of the furs used for the home trade. You no doubt know of the fox farms in Prince Edward Island and the steps likely to be taken to raise other fur-bearing animals in captivity, especially since the fur from such animals brings a higher price than from the same species trapped wild. It is interesting to note that the caribou are so numerous in some parts of Canada that they must be reckoned by acres and square miles rather than by numbers.

CANADIAN WATER POWER

As other fuel supplies decrease, and before, for that matter, water power becomes increasingly important, and the water powers of Canada are more abundant than in any other country. There are 969 waterfalls known to be suitable for the generation of electric power, and already 1,712,193 twenty-four-hour H. P. has been developed, approximately 18,000,000 twenty-four-hour H. P. is in sight, and 8,000,000 of this is within the reach of present markets. The Province of Ontario has the most extensive developments of any province. The great importance of this becomes more apparent when we remember that improved methods of transmission are constantly coming into use, and in Ontario power is now transmitted 242 miles. Such a radius enables this power to be used over an area of 180,000 square miles.

In the central portion of Canada is 2,000,000 square miles, with an average elevation of 1500 feet. All the drainage from this area is to rivers flowing into the St. Lawrence or the sea, and making possible water power so great as to be difficult to compute. It has already been estimated that Ontario and Quebec have available water power equivalent to 8,403,899 H. P. When the total potential H. P. is considered with respect to the area, or population, Canada finds herself as favorably situated as other nations, and when we consider the H. P. per square mile, is well up in the list with other large countries. When we remember that it takes on an average 4 lbs. of coal to develop 1 H. P. hour under favorable conditions, we calculate an amount for the coal which must be burned to make equivalent power, that is startling and beyond our comprehension.

The prices at which hydro-electric power is sold, of course, varies with the amount of power taken and is usually reckoned at the power house, leaving the cost of transmission to the user. Fairly large quantities may be obtained at \$15.00 per H. P. year, larger quantities at a lower price, and there are some old contracts still in operation upon which power is supplied as low as \$4.50 per H. P. year. This figure compares very favorably with the prices in Norway where the fixation of atmospheric nitrogen has found a home, due to low cost of power. You will remember that Dr. Eyde said in 1912 that when their power cost reached \$6.00 per H. P. year they would not be able to compete successfully with other sources of nitrates.

To have awakened such an empire to its possibilities through the employment of methods which have been tried and found satisfactory, is something to be gravely considered.

In conclusion, I will point to a few accomplishments of research work since the war began. One of these is the production of acetone and acetic acid in its various forms, using calcium carbide made electrolytically as the starting point. It is expected that this process, which has just commenced on a com-

mercial scale, will have wonderful advantages in the production of these materials.

Another example is from our laboratories, where we have succeeded in producing a high-grade half stuff for paper, using the waste flax straw as our raw materials. When we consider that more than 1,000,000 acres are put to flax for seed each year, you realize the economic importance of conserving that portion of the product—the straw—which has heretofore been burned.

The particular difficulty to be overcome was the elimination of the shive without detriment to the fiber, and the solution of the problem has naturally given us much gratification. We have also undertaken a very extensive study of straw utilization, and within a year hope to announce important results based on this work. Extensive experiments have also been conducted having for their object the better utilization of natural gas, and the present indications are that successful results have been obtained.

May I conclude by quoting this phrase, "By the study of

natural conditions and development of neglected lines of production, an invaluable degree of general prosperity may be expected"—for Canada. I attribute much of the study now taking place, and about to begin, to the German alarm clock which has gone off with a bang sufficient to startle the world. There are many instances of awakening in the United States, where we are also happy to have a part in the work of progress. We feel especially gratified in being given some part in the development work of a country whose resources I have but mentioned, and whose future certainly seems rosy.

With the world so thoroughly awakened by the German alarm clock, and the near neighbors of the United States fully aware of the advantage which lies in their natural resources, does it not devolve upon the United States to be alert, better organized, and still more appreciative of science than she is to-day?

A. D. LITTLE, LIMITED
137 MCGILL ST., MONTREAL, CANADA

PUBLIC SERVICE SYMPOSIUM

Papers presented before the NEW YORK SECTION OF THE AMERICAN CHEMICAL SOCIETY, Chemists' Club, New York City, November 10, 1916

PUBLIC SERVICE IN THE UNITED STATES

By CHARLES A. BEARD

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The most striking feature of modern politics is the steady increase in the number and variety of governmental activities. It makes no difference what party is in authority. It may be the party of Hamilton and nationalism which was early committed to the doctrine that the powers of the general government should be used freely and generously to protect, assist, and encourage private enterprises; or it may be the party of Jefferson and the New Freedom which, traditionally at least, is committed to the principle that the government which governs least is best. Each party cries out at the type of interference devised by the other and proceeds to propose its own lines of intervention. Democrats solemnly inform us that a protective tariff is unconstitutional and proceed to create a commission of experts presumably for the purpose of discovering what kind of protection is good for the country. Leading Republicans disinter Herbert Spencer's Mid-Victorian doctrines of individualism and publish them to mankind as the latest word on sound politics and then solemnly warn us that unless we have government intervention in the form of a protective tariff, labor and capital will perish from the United States. Democrats defend the government's use of power to establish an 8-hour day or higher wages for chosen workmen and then decry as outrageous the government's interference in the form of a tariff, theoretically favoring the maintenance of a high wage standard in American industries. New York property owners protest in the name of liberty and humanity against orders requiring them to install fire prevention apparatus, and then turn around and demand in the name of good city planning the protection of their property rights against encroachment. Apostles of American individualism are clamoring for the extremist form of subjection to the state, which is known to mankind, namely universal military service. We are told in the same breath that we must retain our traditional rights of person and property and yet be so organized for industry and for war that we can whip the earth on ten minutes' notice.

To speak more concretely of recent developments, the Congress of the United States has established an 8-hour work day for certain railway employees and created a commission to observe its operations—presumably a commission of men charged with the slight duty of mastering the mysteries of railway operation within a period of a few months. It has created a shipping board with extraordinary powers in the matter of building up a national merchant marine. It has passed a Federal

Employees Compensation Law and authorized a commission to administer its provisions. It has founded a Farm Loan Board which will engage in rural banking and be responsible among other things for learning the technicalities of agricultural economics. It has appointed a committee to study the whole problem of government ownership of railways. It has enacted a cotton futures law, a grain standards law, and a warehouse law, all calling for expert knowledge of broad domains of private economy. I shall say nothing of such light matters as the Interstate Commerce Commission, which has had control over all the intricate processes of common carriers, of the Federal Trade Commission, of the work of valuating railways, of pure food laws calling for experts in chemistry and bacteriology, or of state and municipal enterprises demanding the highest talent in every branch of science and economics.

We may differ among ourselves as to the wisdom of this or that act or this or that type of intervention and undertaking, but we know that most of this new governmental functioning is not the product of Democratic perversity, Republican paternalism, or Socialist vagaries—it is the product of our industrial civilization. It may be diminished here or altered there, but it cannot disappear unless we return to the hand loom, the stage coach and the tallow dip, and at the same time, declare ourselves to be pacifists with the courage of our convictions. I may be wrong, but I believe the day is past when any organization of capital or labor will be permitted without government intervention to paralyze or even tie up indefinitely any one of the great industrial processes upon which the life of the people depends. If this is true, then the government has ahead of it more staggering enterprises than any that it has yet undertaken.

The upshot of all government functioning is a great increase in the number of government employees, national, state and municipal. A very competent consulting engineer, Mr. J. L. Jacobs, of Chicago, has recently estimated the number of civil servants employed by all governmental divisions in the United States at a figure between 1,880,000 and 1,980,000.¹ In a short time we shall have two million government employees—a number equal to almost two-thirds the entire white population of the United States when the Republic was established. Already our state, city and federal governments call to their service as many members of the American Society of Civil Engineers as are engaged in private consulting practice, and more than are employed by railway corporations or by private manufacturing and contracting companies.

It is not the mere number of civil servants that raises the most

¹ *J. West. Soc. Eng.*, 21, June, 1916.