

The PRESIDENT then delivered the following Address :—

GENTLEMEN,—In taking this Chair for the first time as your President, I have to thank all here, and the members of The Institution generally, for the great honour they have conferred on me.

I follow a long line of distinguished Engineers, and in accepting the position of your President I cannot do so without some misgiving. My immediate predecessor has had onerous demands made on his time and judgment, and he has met these in such a way as to reflect the greatest credit on this Institution, and at the same time to make it all the more difficult to succeed him worthily. Still! I promise you my best, and I trust to your indulgence. Come what may, the period over which this Session will extend must be an historic one, and all we can do for the present is to look forward with confidence to the result.

Although our business here to-night is to inaugurate another session of the work of our Institution, I feel bound in the first place to make some reference to the gigantic struggle in which we, with our Allies, have since the 4th August, 1914, been engaged, extending now over a period of 1 year and 91 days.

Lovers of peace as we are as a nation, it is satisfactory for us to know that no sooner was war declared than it was universally recognized that our rulers had no other course open to them; that the war had been forced upon us, and in so far as we and our Allies are concerned, we were satisfied it was a defensive and righteous war.

The British Empire stood out in bold relief as a united whole, with the one earnest desire to act in unison in the interest of the welfare of the Empire, the defence of our treaty obligations, and the support of the weaker countries. His Majesty the King in proroguing Parliament said: "From every part of my Empire there has been a spontaneous and enthusiastic rally to our common flag." Never did hostile Power commit a greater political blunder than to assume that British unity was unreal and would fall to pieces when the critical time arrived.

The last memorable occasion on which British troops were engaged in battle on the Continent of Europe was at Waterloo, fought on Belgian soil just over 100 years ago, when Napoleon's career of aggression was overthrown. Great as was that battle, and far-reaching in its results, it cannot be compared in intensity or magnitude with the almost everyday battles of this stupendous war.

Comparing the weapons and munitions of war in 1815 with those

of 1915 is literally contrasting the advances made by industrial science during the last 100 years.

In 1815 the knowledge of the latent energy of steam and its application for producing mechanical work was in its infancy. There were no railways, and little was known of electricity. Telegraphs, telephones, wireless telegraphy and electric cables did not exist. There were no internal-combustion engines, motor-cars and cycles; no air-craft, submarines, barbed wire or machine guns, and no high-explosive shells. The muskets in use at Waterloo were smooth-bore, muzzle-loaded and with flint-locks. The heaviest cannon—also smooth-bore—could only throw a spherical ball of iron 8 to 9 lbs. in weight a distance of a few hundred yards, as against the heavy artillery of the present day, capable of throwing a shell of nearly a ton in weight an effective distance of more than 15 miles.

Seeing the perfection to which fighting appliances have been brought, it might reasonably be expected that war would become impossible. We fear we may take it for granted that war will recur so long as nations have to follow the leader in the matter of amassing armaments of destruction. It is earnestly to be hoped that the highly-organized methods of warfare now in use may demonstrate once for all the insane folly of sacrificing human lives and the necessity of finding out a better way of settling international disputes.

It may well be asked, what has this got to do with engineers? My reply is, that while it concerns the nation at large, it appeals in a special manner to the engineer.

This war has been rightly styled the engineers' war. Our efforts as engineers have been made use of to the full extent in waging the war. None the less, we should be still more willing that our training and experience might be utilized in prosecuting and furthering the arts of peace.

The voluntary effort of those on the roll of this Institution to take a personal part in the military operations is indicated by the fact that already some 1,500 of our young men have joined His Majesty's forces, for the most part in the commissioned ranks. Of these, naturally a number have become attached to the engineering branches of the Navy and Army, and, in respect to the Army, the President of The Institution has since August last year, at the instance of the War Office, made recommendations from time to time as required by that Department.

In addition we must not forget the still larger number of those belonging to this Institution who, many of them in voluntary and

unpaid capacities, are engaged in the manufacture of munitions of war of all kinds and in military transport.

In this commodious building, since last autumn, we have afforded accommodation to the staff of an important War Office Department. During the earlier part of this year we gave all accommodation in connection with the establishment of the extensive organization known as the "Metropolitan Munitions Committee," of which my immediate predecessor is chairman, and more recently we have undertaken to accommodate a considerable branch of the Explosives Department.

Whilst each one of us, according to his ability and opportunity, is endeavouring to do his best for the national cause, and for the success of the British arms, we cannot ignore the fact that the circumstances have involved great sacrifices among professional engineers, and I fear we must look for a certain amount of distress to follow.

Professional engineering work has been adversely affected to an extraordinary degree by the need, which is realized by all, of husbanding the national resources and arresting the prosecution of a large number of those undertakings which in the usual course employ professional engineering skill.

Whilst sharing the view that much expenditure and application of labour, which is not directed to military needs, should be suspended for the present, we may well doubt whether it is a truly economical course to postpone, even under the present circumstances, the contemplation and professional consideration of engineering works, for which the call may be expected to be acute when the war is over.

It appears to me that many engineers whose age and circumstances prevent them from taking an active part in connection with the war might well be devoting their skill to the deliberate preparation of such projects as I have referred to. The cost necessarily involved would be very small, and there can be little doubt that the country would be in a better position to resume normal activities in the future, if effort which cannot be made use of otherwise were applied to the preparation of designs for work which is certain to be undertaken under some pressure when the time comes.

Another matter which must exercise our minds in connection with the future of many of the young men who have volunteered to serve the country is, what will be the position of those of them who have embarked upon or contemplated an engineering career, which has been completely broken off? It is impossible to create a competent engineer without due training and experience, and we

will no doubt have to consider somewhat specially, at a later date, the position of those young men whose preparation for the engineering profession must be, owing to the war, regarded as imperfect, according to the existing rules of The Institution.

A feature of great interest brought home to us by the present situation is the practical effect of the war upon the distinction hitherto existing between civil and military engineers. It is difficult to see how this position can be reasonably maintained in the future, at least on the definite lines observed in the past, as the roll of The Institution already includes a considerable number of those who are serving as officers of the Royal Engineers, engaged in military operations.

The conveyance of the various units of the Expeditionary Force to the ports of embarkation, and the movement of troops and supplies generally, has been most efficiently carried out by an Executive Committee of Railway General Managers and experts.

The railways of this country are the wonderful creation of private enterprise, but it must be admitted they were located and designed with a total disregard to strategic advantages, and especially of a possible invasion. While we may firmly believe that this country will never be invaded, it is only prudent to be prepared for the worst, and immediate steps should be taken to remedy our defects in this respect by connecting up existing lines and by extensions. Were the country invaded, the attack might be made on any of our weakest points to be found among the most remote spots on the coast, and to meet such a contingency provision should be made to protect these and to connect them by means of either motor roads or railways, or both.

Such roads and railways would serve the double purpose of meeting the necessities of defence and the requirements of civil life, by opening up the country, especially the outlying portions, and bringing land areas, forests, quarries, and products of every description within the marketable zone.

While we commend the efficiency with which troops have been moved inland, we can find no adequate language to describe the splendid efficiency with which the overseas transport service has been effected.

Many instances can be imagined where the civil requirements and the military necessities would each gain by combining and working together. Unfortunately, in this country we are liable to work in compartments. While we have every confidence in our united Army and Navy, the civilian must not be left out of the calculation. To ensure the best results of our public undertakings,

the best known experts, whether they be financiers, engineers, business men, chemists or scientists, should be available and utilized.

This war presents as an outstanding feature the enormous extent to which the trench has been used. On the western front it has extended for a length of about 450 miles, and the armies have stood facing each other for months; and on the eastern front it is much the same, but to a larger extent, being anything from 700 to 1,000 miles in length—walls, as it were, of living men.

In the third century the Romans raised a rampart of earth across this country from the Solway Firth to the mouth of the Tyne, and in the fifth century China built its Great Wall as a defence against invaders. In our own country we walled in our cities, built fortified castles with ramparts, moats, drawbridges and portcullises, and latterly we have constructed masked forts and other strongholds mounted with guns.

None of these, even the most recent, are proof against the guns, projectiles and explosives of the present day, and of all the protective devices practised from the earliest times down to the present the trench survives as the most effective. If the past ages could afford to construct such expensive protection, does it not suggest itself to us that we should, at selected places, provide permanent, well-constructed residential trenches?

As an example of how the civil and military requirements may co-operate, we frequently hear it said to be necessary that London should be provided with yet another outer-circle railway. Clearly such a line of railway, by being connected with the railway systems all round, might be of great strategic value, and if in addition permanent trenches such as I have referred to were constructed outside and parallel with it, they would be available at all times, and troop trains could be quietly run in at a moment's notice.

If such an idea is good for London it would be equally good for other places.

Let us now pass on to consider whether we are, as a nation, making the most of our national resources from an economic point of view, especially as regards some matters that particularly interest the engineer.

IRON AND STEEL.

Take, for instance, the iron and steel industries and their raw materials.

In 1894 the United Kingdom stood highest in the production of iron ore. The following Table, which has been compiled from

Parliamentary returns,¹ gives the contrast, in the production of iron ore by the principal countries, between the years 1894 and 1912:—

	1894	1912
	Tons.	Tons.
United Kingdom produced . . .	12,367,000	13,790,000
Germany	12,193,000	32,190,000
France	3,711,000	18,744,000
Belgium	306,000	165,000
United States	11,880,000	55,150,000

In 1896 the United Kingdom led the world in the production of pig iron, and the following Table, also compiled from Parliamentary returns, gives the contrast, in production of pig iron by the principal countries, between the years 1896 and 1912:—

	1896	1912
	Tons.	Tons.
United Kingdom produced . . .	8,660,000	8,751,000
Germany	6,270,000	17,582,000
France	2,301,000	4,870,000
Belgium	944,000	2,264,000
United States	8,623,000	29,727,000

It is satisfactory to observe that as regards iron ore and pig iron we have not lost ground, notwithstanding that our advance in comparison with other nations is very small.

Although the Bessemer process was discovered in 1856, its use for the production of steel did not assume commercial importance until the late sixties, and it was not until 1868 that "Siemens" open-hearth steel was first manufactured, when iron ore was made use of to oxidize the carbon and silicon in pig iron. Shortly afterwards the use of iron and steel scrap for this purpose, introduced by Pierre Martin, produced the Siemens-Martin process, and both methods became effective in the early eighties.

At first both the Bessemer and the open-hearth processes were "acid," requiring the use of non-phosphoric ore in the manufacture of the pig iron, but in 1877 Messrs. Thomas and Gilchrist took out their first patent for the basic process; and the great development of steel-making on the Continent dates from the adoption of this

¹ Iron and Steel, 1912. Parliamentary Paper No. 284, Session 1913-14.

invention, which has in particular given value to the large deposits of easily-worked Minette ores of Luxemburg and French and German Lorraine.

The development of the basic process, particularly the open-hearth basic, has been much slower in this country, for various reasons; but in view of the large deposits of phosphoric ore in the Cleveland district, there seems to be no reason why greater progress should not be made.

A more striking view of the position is obtained by examining the average annual production of steel per head of population in hundredweights:—

	1889-93	1894-98	1899-1903	1904-08	1911	1912
United Kingdom . .	1.8	2.0	2.4	2.7	2.9	3.0
Dominion of Canada .	..	0.1	0.3	1.5	2.2	2.3
Russian Empire . .	0.1	0.2	0.3	0.3	0.5	0.5
Sweden	0.7	0.9	1.1	1.4	1.7	1.8
Germany	3.4	4.5	5.1
Belgium	0.8	1.7	2.2	3.6	5.7	6.5
France	0.4	0.6	0.8	1.2	1.9	2.2
Austria-Hungary . .	0.2	0.4	0.4	0.7	0.9	1.1
United States . .	1.3	1.8	3.3	4.4	5.1	6.6

Summarizing our positions, we have not made the same rapid advance shown by our rivals, and it becomes necessary that by an extreme effort, and by adopting the most up-to-date methods, we should make every endeavour to hold our own, and especially to avoid the necessity of importing steel, which we did in 1913 to the value of £15,000,000. This is distinctly disappointing, and I hope it may be taken into consideration by all concerned.

It is true our steel manufacturers are liable to severe foreign competition, and at times are subjected to what is known as “dumping,” and clearly they ought to have some security against this unfair method of attack.

It is eminently satisfactory to know that British iron and steel occupy the highest position as regards quality, and that we are keeping abreast with respect to the higher-class steels. Nevertheless, it is most desirable we should increase our output, and to do this it is a first essential that the raw materials should be assembled cheaply. What we are short of in this country is abundant in other parts of the Empire, and every effort should be exerted to cheapen its transport.

The prosperity of the iron and steel industry of a country may be taken as a measure of the prosperity of the nation. This being so, it follows that we should exert ourselves to the utmost to maintain and develop in this direction, and all interested should combine to secure this result.

TIMBER.

Timber, another material largely entering into construction, and of special interest to the engineer, is in a most unsatisfactory position so far as home cultivation and supply is concerned. Undoubtedly, as regards forestry, we are in this country years behind any other European nation.

Forestry and the cultivation of timber is different from almost any other trade or business, inasmuch as that it is barely possible for the person who plants the sapling to cut the same down as a tree at full maturity. Generally speaking, what one generation plants probably the third generation reaps. Hence to an individual there is just that lack of inducement which fosters a tendency to neglect forestry, and which produces a disinclination to find capital for the benefit of some other person, possibly an unknown person.

Timber cultivation should proceed continuously without any lapsed periods, and one generation, after getting reasonable use of what has been handed down to it, should leave an equivalent value to the next generation, and so on.

To carry on this rotation, it follows that for every tree cut down, two, if not three, young plants should be substituted, to ensure the survival of the fittest. No such systematic attention has been given to the forests of this country, with the unfortunate result that we are almost wholly dependent on other countries for our timber requirements.

As long as our ships of war were built of timber, our Government, and indeed the public, took a sustained interest in the forests, and especially in the cultivation of timber used in ship-building; but gradually, however, as our men-of-war, mercantile marine and sea-craft generally came to be constructed of steel instead of timber, public interest in forestry died away, and it was not until about 1880 that the idea of applying modern methods to the management of the forests was entertained, and special training was established at Coopers Hill and other colleges in connection with the Indian Service.

In 1885-7 a Select Committee investigated the subject of Forestry, but its report concerned itself chiefly with the promotion of forestry education and the establishment of a Forestry Board.

These suggested powers were conferred on the Board of Agriculture and Fisheries by the Act of 1889. Subsequently Departmental Committees and a Royal Commission investigated the subject and invariably recommended the purchase of demonstration areas and the extension of forestry education.

These proposals, admirable in themselves, were largely of an academic and experimental nature, and until the Development and Road Improvement Funds Act, 1909, came into operation, money was scarce and there was no security of any being forthcoming. Still, in 1903 schools for working foresters were established, which are considered satisfactory.

The Board of Agriculture and Fisheries and the Office of Woods and Forests and Land Revenues issued a joint report for the year 1912-13 on the forestry under their jurisdiction. They deal with each forest in detail, and in no case do they find one to be in a flourishing condition, and they cannot help coming to the conclusion that forestry in this country is in a backward state.

With the support of a grant from the Development Fund, large demonstration areas have been secured and lectures have been established at various colleges throughout the country, and much actual work of an experimental character has been effected.

In clearing and replanting, difficulties had been met with in disposing of branch wood and small and crooked timber, and to meet these an experimental trial plant has been established for the distillation of wood and for the production of wood-tar, acetate of lime, charcoal and wood-spirit.

These various measures are excellent so far as they go, and will in time produce much good. Still, as planting only commenced 3 to 4 years ago, and that, too, over a limited area, and as it takes many years for trees to come to maturity, depending on the species, it follows that it will be a long time before full advantage can be attained.

At the end of 1913 the areas of forest lands in the United Kingdom were:—

	Total Acres.	Crown Acres.	Total Acres other than Crown (privately owned).
Forests in England and Wales .	1,884,100	64,700	1,819,400
„ Scotland	868,000	1,000	867,000
„ Ireland	306,660	10,000	296,660
	3,058,760	75,700	2,983,060

Private forests present a grave problem. Although many proprietors have done good and advanced work, in many cases the owners have been living more or less on the past and planting has not been systematically carried out. It is not at all likely that owners of large forests will—nor indeed can unaided—develop these to their full extent, and in many cases transit difficulties constitute a serious barrier.

Acknowledgment is due to the Royal English and Scottish Arboricultural Societies and the Irish Forestry Society for the great help they have consistently given to forestry.

In this country we can grow almost all the trees of commercial value excepting mahogany and other finer hardwoods and certain Oriental trees, and we are particularly well adapted as regards soils and climate for growing and cultivating the various conifers, larch, fir, spruce, Corsican firs, and others of those most used in structural work and for commercial purposes.

In 1912 we imported—

	£
Unmanufactured timber to the value of . . .	28,357,000
Manufactured " " " . . .	3,393,000
Wood pulp to the value of	4,418,000
Total	<u>36,168,000</u>

We exported in one form or another £3,582,000

This apparently represents a good deal more timber than this country could produce under the most favourable circumstances, even if new areas were planted. Notwithstanding, we can almost immediately—or, at any rate, in the course of time—reduce our imports very considerably; but particularly is it desirable that we do not import manufactured timber, chiefly consisting of doors and windows and their frames.

Having unfortunately allowed ourselves to get so far behind with our home supply of timber, what is to be done? Clearly, we cannot wait until, by means of the scientific investigations set up, we ascertain what trees are the most suitable for the various soils and the different parts of the kingdom and what are the best systems of planting.

We have abundance of evidence that we can grow certain trees, and we have with us a race of good shrewd foresters and woodmen having a practical knowledge of planting, clearing out, ventilating and draining forests, and it is to be hoped that, without further loss of time, means may be taken to deal with our forests generally and continuously.

But what are we to do in the meantime for our timber supply? It is well known that there are numberless trees in our forests, alongside our highways and lanes, in the field hedges, and groups in the fields themselves—very many in our parks—fully matured and ready to be cut down, a large number overmatured and in which deterioration has commenced, and again large numbers in an advanced state of decay.

No doubt certain economic reasons could be given why this waste has been permitted, such as the scattered positions of these trees, transit difficulties, and in many cases the reluctance of owners to part with their trees, a sentiment which would fail in strength if younger growths were standing alongside. Still, the situation should be faced, and no doubt means could be devised to meet these difficulties, and so secure timber for our home consumption.

The importation of timber has been steadily on the increase, and in 50 years has advanced from £9,058,000 in value to £23,675,000,¹ and during recent years prices have been on the ascending scale. Timber is constantly being put to an increased number of uses; particularly is to be noted the enormous quantity cut down year by year and converted into wood pulp.

Of the timber imported, roughly one-fourth comes from the British possessions, chiefly from Canada, and the remaining three-fourths from the United States, Russia, Sweden, Norway, Austria, France and Germany, mostly from primeval forests.

Most of the British possessions grow excellent timber of every species and variety. Canada, for instance, has an area of about 3,650,000 square miles. The area of the forests is roughly about 1,250,000 square miles.

Of the total area called forests, only about 26,000 square miles, or about one-fifth, is said to grow timber of real commercial value, the other four-fifths being of small growth. Still, the area of valuable timber is enormous, and under progressive treatment must have a great future.

It is all-important that until we can depend more on ourselves for our requirements, we should save the use of timber as much as possible by the substitution of other materials, and by the scientific application of the most approved means of treating and preserving timber, so as to render it as lasting as possible.

The railway-companies in the aggregate consume enormous quantities of timber for various purposes; as an instance, their annual consumption of sleepers, 9 feet long by 10 inches wide by

¹ Joint Annual Report, Forestry, 1912-13, p. 65.

5 inches deep, must amount to millions. An immense saving of timber would be effected if a suitable substitute could be found. Many attempts have in the past been made in this direction with some measure of success, yet never completely satisfactory results. Still, success is quite within the bounds of probability, and is well worth an effort. Anything that will either decrease the imports or increase the exports must obviously be of national importance.

FLOODS AND LAND-DRAINAGE.

Still following up our inquiry as to whether we are taking advantage of our natural resources, let us consider our position as regards floods and the drainage of land. Any observant person moving about the country cannot fail to notice large areas of water-logged land, and in many parts extensive districts subject to flooding.

It is first of all essential to effective drainage that surplus water should have a free outward flow. All water must, sooner or later, find its way into the running brooks, streams and rivers by which it is conducted to the ocean. It therefore follows, as a condition precedent to good drainage, that the streams and rivers should themselves be so regulated and controlled as to afford a free and uninterrupted flow.

We cannot shut our eyes to the fact that in many cases our rivers and their tributary streams are not only unable to take the flood waters, but, on the contrary, their condition is frequently the cause of the damming back of water on the lands adjoining.

We need not go far for examples. The River Thames, flowing past our doors, now and again rises in flood, and notwithstanding many improvements carried out by the Thames Conservancy above Teddington, in dredging, renewing and widening locks, weirs and sluices, and in regulating the discharge of flood water, still, at times, it overflows its banks and floods large areas of land, streets and dwelling-houses, causing much damage to produce, crops and property.

The Thames is by no means an exception. There are large areas of land in the valleys of numerous other rivers in England, Scotland and Ireland which in times of exceptional rainfall are deeply flooded, causing in the aggregate enormous losses to land-owners and their tenants.

The largest agricultural areas subject to floods are on the east side of England, and are included in the valleys of the Waveney, the Bure, and the Yare, all discharging into the sea through the

narrow channel of the Yare at Yarmouth, and in the valleys of the Great Ouse, the Nene, the Welland, and the Witham, flowing into the Wash through separate channels.

In many cases measures for improvement would meet with difficulties, and the works might be costly, but in not a few instances a quick return might be expected, while in others the improved value over a period of, say, 25 or 30 years would be sufficient to redeem the capital expenditure.

It is not, however, always the case that in the valleys of rivers with the least fall or the most sluggish flow the greatest damage occurs. As an illustration of this fact I may refer to the River Spey.

The Spey is credited with having the most rapid flow of any river in this country. It is about 100 miles in length and has a fall of 1,145 feet, or a rate on the average of nearly 12 feet to the mile. The river flows in a north-easterly direction, and takes a sinuous course through a wide and fertile valley sheltered for the most part by high mountain ranges on each side. Needless to say, on the mountains on each side forming the gathering-area the rainfall is heavy, and is intensified at times by melting snow. Hence the river is subject to sudden and violent floods.

Notwithstanding the advantages of an abundance of fall, this river, especially for the upper third of its length, is most destructive; so much so, that of the area of the lands adjoining the first 30 miles, thousands of acres are permanently soaked with backwater and rendered unfit to grow anything better than rank grass and rushes, while the greater part of this area is little better than a marsh, a striking contrast to neighbouring land where drainage is possible.

Rivers situated like the Spey are fed from both sides by streams rushing down the mountain sides and joining the main channel at right angles to the flow, carrying with them loose stones and gravel, which form obstructive barriers across the river and sectionalize it into pools and currents, preventing an easy and uninterrupted flow.

A good deal of laudable but isolated effort has been made, by forming embankments and executing other works, to minimize the destructive effects of the floods, but it is obvious that works in the higher parts of the stream will not benefit the lands below, and it is not to be expected that a riparian owner of the lower part of the stream would incur large expenditure which would mostly benefit the lands above. Clearly, in the case of any river it must be dealt with comprehensively as a whole, and that can only be done under legal authority backed by financial support. To rectify and correct

the River Spey would not involve an onerous financial burden compared with the immense benefit which would accrue.

I cite the case of this river as an example within my own knowledge, but although an aggravated case, it is by no means an exceptional one. It may, however, be taken to be typical of numbers of rivers flowing through the valleys of the mountainous portions of the kingdom, and it is to such sheltered valleys that we must look for a large addition to our available productive lands.

In dealing with rivers, every case must be considered on its merits. In certain instances much harm might be done by disposing of the water stored up inland and gorging the outlet, and it must not be forgotten that the more perfect the arterial drainage of the country, the more rapid will be the discharge of the flood waters, and provision should be made accordingly.

Again, in considering damage to lands by floods, we must differentiate between grazing lands, where an occasional flood does little damage, and agricultural lands, over which immunity from floods must be secured.

While flooding of considerable areas frequently occurs, great floods in certain districts caused by excessive rainfall take place at only long intervals. Thus in the flat fen country in South Lincolnshire and Cambridgeshire there were nine consecutive wet years in the period 1875 to 1883, when very serious damage was done. No such wet periods occurred again until August, 1912, when large areas in South Lincolnshire, Cambridgeshire, Norfolk and Suffolk were inundated.

During the earlier period, and on the last occasion in 1912, public attention to the consequent loss became thoroughly aroused. In 1877, 1878, 1879 and 1881 Bills were introduced into Parliament for dealing with Floods Prevention and for establishing Conservancy Boards. They all, however, failed, owing to the difficulty of rating an area sufficiently large to provide funds for the cost of improvements.

Up to last year the only general legislative enactment by which Drainage Districts or Commissions of Sewers for the purpose of dealing with any flooded or waterlogged area could be created was the Land Drainage Act, 1861. The scope of this Act, however, is limited, owing to the fact that under its powers the consent of the owners of two-thirds of the area of any proposed drainage district is necessary before a Provisional Order can be obtained.

After the great flood of August, 1912, and on the representation of many private individuals suffering from the losses incurred, the Development Commission and the Board of Agriculture instituted

inquiries into the condition of the rivers in Norfolk and Suffolk and those discharging into the Wash. The inquiries revealed a hopeless complication of authorities established by various Acts of Parliament in nearly all the rivers. Some of these authorities were charged with the duty of maintaining parts of the river embankments, some with the clearing of the bed, and some with the navigation, but in no case was one authority able to deal with any one river as a whole.

As a result of these inquiries the Board of Agriculture at the end of last year promoted a Bill in Parliament for the purpose of creating an authority in any river valley by Provisional Order, conferring the power on this body to undertake certain specified works of improvement, and in order to provide for the cost to issue precepts to the authorities to levy rates in certain proportions according to benefit on their rateable areas.

This Act, under the title of the "Land Drainage Act, 1914," received the Royal Assent at the end of 1914.

Enough has been said to show that, for the present, legislative machinery does exist by which, under the pressure of public opinion, improvements in rivers may be brought about.

I have dealt longer with rivers and floods than my time warrants, but the subject is so all-important that I must claim justification. I have no hesitation in saying that if our rivers and watercourses could be effectively dealt with and our waterlogged lands, fens and bogs trenched and drained, we could, by the land so reclaimed, add a considerable percentage to the existing area of arable and pasture lands of this country.

Given the capital, there is no difficulty which cannot be surmounted, and many successful examples can be cited. The first step taken towards the arterial drainage of the fens was in 1631, and the drainage operations there since that time have yielded results such that to-day there is no more productive land in the country.

Patricroft Moss and Chat Moss, of which we engineers have heard so much, have nearly disappeared as such, and are now under cultivation, and there are numberless cases where ordinary waste areas have been converted into fertile lands.

While rivers and watercourses should be trained and controlled for local benefit, it should not be overlooked that they are of greater value as a national asset. Rivers may generally be divided into three sections: the lower section, subject to tidal flow; the middle section, flowing generally through flat lands with little fall; the upper section or reaches, with invariably a superabundance of fall.

In many rivers the high water of spring tides flows for long distances inland, and where this is the case, a river could be easily canalized and rendered available for the smaller ocean coasting vessels, for carrying goods much nearer to their destinations, and at the same time relieving the congestion of the larger docks at the mouth of the river.

Already we have a number of instances where this has been done. The Forth, the Tyne, Wear, Humber, Witham, the Great Ouse, and Thames on the East Coast, and the Severn, Weaver, Mersey with the Manchester Ship-Canal, the Preston Docks on the Ribble on the West Coast, and the Trent, for which powers have been secured. There are still many rivers which so far have not been dealt with.

From the point where the tide has ceased to flow up the river, the second section can be canalized by means of locks; and as to the third section, it is really a question, when goods have to be transhipped in small bulk, whether it pays to canalize, and the lack of sufficient water-supply in the higher lands constitutes a serious drawback.

The old canals, wonderful in their conception and execution, are another example of private enterprise uncontrolled from a national point of view. A canal direct from an industrial centre to a dock on the sea-coast is a system in itself, but, generally speaking, in the laying out of the canals of this country no organized system had been kept in view. Some of our broad-gauge canals have already been much improved, such as the Aire and Calder and the Weaver Navigations, and there are some left which are subject to improvement, such as the South Yorkshire Navigation.

While carriage by water should be encouraged, I question whether much good could be obtained by reconstructing the greater number of the existing internal canals, more especially the narrow-gauge ones, and it is a question whether their sites might not be more profitably utilized for other purposes.

The subject is altogether too big for to-night, but what I want to make clear and impress on our minds is that we are not utilizing our water resources, either as rivers, streams, or lakes. We want, in short, some organizations with power to control all our water resources and to centralize and consolidate our gathering-grounds and water-yields.

The only object we can have in view in adding, at a great cost of labour and money, to the productive lands we already possess, is to place at the disposal of the community the possibility of increasing

our home production, with the intention of meeting our own requirements to a much greater extent in the future than we have done in the past.

In this connection we are bound to ask ourselves whether we are making the most of the land now available, and after consulting living authorities and writers on the subject and examining returns, the answer must emphatically be in the negative.

I do not intend to discuss land and agricultural matters before the members of this Institution—notwithstanding these transcend in importance any other industry in the country. As regards agriculture we appear to occupy a singularly anomalous position. We can exhibit the finest stock of all kinds in the world, and on the whole we have maintained superiority, but in numbers instead of advancing we have declined.

Then again as regards crops. In many instances we obtain magnificent yields, but our average results are only about two-thirds of our best, and all round we fall below the yield of most other nations. This clearly indicates that, while we have a number of first-class cultivators, there must be a large number operating on obsolete lines. We are glad, however, to note that during the last few years renewed interest has been taken in agricultural matters generally, and by the aid of agricultural colleges and demonstration farms much scientific and practical knowledge has been collected, showing itself already by the returns of 1912–13 being an improvement on those of previous years.

The older men, owners and occupiers of lands, will tell almost pitiable tales of the trials they had to endure to meet the ever-shifting conditions.

About 40 years ago the importation of live stock of all sorts prevailed, but scarcely had everyone settled down to this new condition of things than the engineers and chemists who in the meantime were at work perfecting a system of refrigeration, completed their labours, and the live trade in animals was immediately replaced by the importation of the dead.

The cultivators of the soil were again placed in a difficulty, and this being enhanced by the ever-increasing importation of cereals in general, but especially wheat, they were forced to the conclusion to cultivate the soil as little as possible. The natural result is that the area of land under cultivation is much reduced and the quality of the soil is undergoing deterioration.

All this time the production of other countries went up enormously, while our exports—never large—have declined, and our imports of grain, flour and wheat have steadily increased during

the last 30 years, and in 1913 they reached the enormous value of 142½ million pounds sterling.

A further result is that emigration has continuously increased, and in 1913 more than 300,000 persons left this country, equal to the population of one of our largest towns. These were not the surplus population, but the very bone and muscle of the country.

We frequently hear that rural depopulation is occasioned entirely by the land and farming conditions. To get at the root cause we must look back many years to find that the first economic conditions to strike at the balance of the population between town and country was the prohibition to manufacture certain industrial articles in private dwellings, which, in conjunction with the advance in machinery, resulted in the concentration of industries in separate large buildings or manufactories, mostly established in towns with transit facilities.

Thus employment becoming scarce in the country occasioned the first great emigration to the towns. Other disturbing economic conditions followed in succession, and the country gradually became to the young a dull place, and the town lure drew them thither.

How the equilibrium of population between the town and the country is to be restored is a difficult problem. Agriculture, owing to improved methods and labour-saving appliances, provides far less employment year by year. Still, a better distribution of larger areas of land with a higher and more intensive cultivation would reinstate some of the population. Afforestation would account for some more, but to re-populate the country to the full extent industries must be established, with such facilities of transit and otherwise as will offer inducements on a paying basis; and with the advance made in hydro-electric science most parts of the country offer facilities for securing cheap power.

Much has been said with absolute truth of the want of housing accommodation. People nowadays will not live in isolated places dispersed throughout the country. The human race is, after all, gregarious in its habits, and to provide acceptable accommodation we must extend the pretty hamlets we meet with everywhere, and provide new towns on pre-arranged plans with suitable and cheap travelling facilities.

How to advance the farming interests it is difficult for me to suggest; but it is evident, to get the full use of the land, these must be helped and stimulated somehow. Combination and co-operation have done much in other countries, and so have central markets and national land banks by providing cheap money and giving reasonable credit.

Rather than give any views I may hold, I will quote Professor James Long, himself a practical farmer and a well-known writer on agricultural subjects, from his work entitled "Making the Most of the Land." He says: "Not only do we need improvement in our methods of production, but of securing what we grow. Our cultivated area needs expansion, broad acres still employed as sheep runs or utilized for sport must be reclaimed. Sandy moors and peat land all respond to kindly treatment and to the ingenuity and skill of man. Our live stock could be doubled in number and the quality commensurately improved, and our crops might be increased by one-half. What is done by a few can be accomplished by all, where the conditions are equally balanced and there are British farmers who accomplish great things, while others achieve nothing at all."

After describing certain artificial fertilizers Professor Long goes on to say: "There is nothing in romance or ancient story more thrilling than the fact that by the employment of artificial fertilizers in one case, or by new selection of plants in another, man is now able to clothe the almost barren hills with rich verdure."

We may take it that it can be demonstrated:

That by proper treatment of the arable land now available, by proper rotation, and by using suitable fertilizers the average yield per acre can be largely increased.

That the live stock, while being maintained at the present high standard, may be increased in numbers.

That by river improvements, drainage and reclamation from the sea and inland waters and of the fen lands, and also by the reclamation of moorland wastes, large additions can be made to the arable and the pasture lands of this country.

If we feel satisfied that these statements are true, no time should be lost in applying the remedy. Why should we import our foodstuffs if by an effort we can remove the lethargy, if not the indifference, of the past, and can largely provide ourselves?

By commencing at once we can correct many things and help ourselves to a large extent immediately, although it may take many years before we can reap the full benefit; but there seems no reason to doubt that in course of time the United Kingdom would be in a position to supply its own simple necessities: and if instead we say the United Empire, then indeed we can provide for all our wants.

Now is the time for the authorities to set about instituting a searching inquiry into all matters bearing on economic subjects, and be prepared to commence relief works of utility of all kinds as soon as our gallant soldiers return, and in no more suitable

situations can they be employed than in their own part of the country and among their own friends.

It may be objected that all these suggestions involve the expenditure of large sums of money—never more scarce than now. The underlying idea of making the proposals is that, for the future, we shall be more independent of outside aid, while at the same time we should be retaining our capital within our own shores.

In our last normal year, 1913, our imports were largely in excess of our exports. It is true that imports are subject to deductions on account of specie and returns on foreign investments and securities. Discount them, however, how you will, they are far too high, and we believe that, with a highly organized system, united effort and foresight, we can save millions, and raise our credit to a high standard.

It is undeniable that we have been lavishing our resources on other countries regardless whether prospective friends or foes; we have received a salutary lesson, and our great hope is that we may profit thereby.

Sir ALEXANDER KENNEDY remarked that it was one of the privileges of an ancient Past-President to be allowed to move the resolution which he held in his hand. He thought if the subject of the President's Address could be summarized in one sentence, it would be, perhaps, called "Engineering as a National Duty, and Engineers as a National Asset." He was glad the President had not been afraid to say outright things which many people might disagree with or desire to discuss—things on which there was much difference of opinion, although there was unanimity as to the results desired. He hoped that when the happy time came when the war was over, the authorities who had to deal with such matters would look up what the President had said as to the national duty in matters with which engineers were particularly concerned, and in which they could particularly help. He had great pleasure in moving: "That the best thanks of The Institution be accorded to the President for his Address, and that he be asked to permit it to be printed in the Minutes of Proceedings."

Sir WILLIAM MATTHEWS said he seconded the resolution with great pleasure, and congratulated the President on his very interesting Address, the preparation of which must have entailed much investigation and labour. It was to be hoped that, either before the war was over, or as soon as possible afterwards, steps would be taken to transfer to the industries of this country the production of much of the materials, consumed by engineers, which

in recent years had been supplied by enemy countries. He was quite sure that Mr. Ross, at the end of his year of office—the duties of which, in consequence of the war, would be considerably increased—would quit the Chair under similar appreciative circumstances to those which had attended the leaving of the Chair by their esteemed Past-President, Mr. Hall Blyth.

The motion was carried by acclamation.

The PRESIDENT, in acknowledging the resolution, remarked that his subject was one not usual in The Institution, but times were changing, and he had thought that an economic subject was the right thing for this year. He would be pleased to have the Address printed in the Proceedings.

THE PRESIDENT then distributed the Telford medals, and the other awards made by the Council in respect of Session 1914–15 were announced. A reception was held subsequently in the Library.