universal peace can only be attained when the preponderance of military power has passed into the hands of the pacific peoples. It is, in short, a world in arms that is desiderated. It is argued that as the independence of the States was achieved by an appeal to arms, so its future immunity can only be secured by like means. If force was necessary in the infancy of the nation it is the more essential now, having regard to the command men have secured over the powers of nature. Apprehension is expressed at the eventual attitude of Great Britain as the greatest naval Power, but really with but little justification, since a war with the United States on the part of Great Britain, however much provoked by unscrupulous commercial enterprise or methods, is entirely unthinkable. Rightly considered, the position of the United States is unassailable by any European Power, and having regard to its immense natural resources, to its great and increasing population, to its vast potential and acquired wealth, it occupies a unique position in the civilised world as a preponderating, moderating influence for good in the comity of nations. It is a great factor for the future well-being of mankind that so vast an extent of territory should be under one flag and subject to one polity, and that its people should be mainly concerned with the internal development of its great possibilities.

Science in all its varied aspects has an immense field in the United States, whether in its application to the development of agriculture (the country is now the greatest grain-producing area of the globe, with the lowest yield per acre), to the electrical utilisation of its abundant water-power, to the exploitation of its vast and varied mineral deposits, to the creation of a great mercantile marine, or to the applications of scientific discovery to the production of synthetic products of all kinds. The example of Germany may fitly be followed here. Much has undoubtedly been done in the establishment since 1861 in all the States of well-equipped agricultural colleges and by the extraordinary munificence of her wealthy citizens in founding and endowing colleges and universities. The example of Germany has taught the people much, and it has been accentuated by the efficiency displayed in the course of the war.

The best minds in the States are deeply engaged in the consideration of the factors which will in their application make for the betterment of all classes of the people, not the least of which is education, widespread and sound in all its grades, in which science will play its effective and humanising part, not as a destructive, but as an ameliorating agency.

The vast expenditure it is recommended to incur upon "preparedness" for war would, if devoted to measures for the better education and amelioration of the conditions of life of the people, be a surer guarantee of peace than any warlike preparations, however effective, with the added advantage that the best interests and the highest happiness of the nation would be secured and advanced.

THE PEAT INDUSTRIES OF WISCONSIN.[1]

IN a report recently published upon the peat resources of Wisconsin, Mr. F. W. Huels describes the attempts which have been made to utilise peat in that State. In one of these, the Lamartine Peat, Light and Power Company manufactured machine-turf on a moor near Fond du Lac during the years 1905 and 1906. The peat, which was raised from the bog by a dredger, was macerated and moulded in a modified form of pug-mill. The air-dried turf was sold for twenty-five shillings per ton at Fond du Lac—the nearest town—which was seven miles from the factory. As the fuel contained about 17 per cent. of ash, it is obvious that, at the price, it could not compete with coal. The factory was closed in 1906 and has not since been reopened.

The Whitewater Peat Company in 1902, at a bog more favourably situated with regard to transport facilities than that of Fond du Lac, manufactured press-turf for a short time. The estimated cost of the product was eight shillings per ton. With a view of avoiding the necessity of waiting five weeks for the air-drying of the poet, attempts to introduce artificial drying were made, and, as might have been foreseen, the failure of the company followed.

As a result of a detailed examination of the whole question, Mr. Huels concludes that little use will be made of the Wisconsin peat deposits until at some period in the distant future fuel has become scarce and expensive. This conclusion, although justifiable in the case of peat, like that of Wisconsin, with high ash content, does not apply to peat of low ash content, such as that found on many of the European moors, and, indeed, it is even possible that the further prosecution of the experiments on the manufacture of power-gas from peat, carried out at the University of Wisconsin, may lead him to a reconsideration of his decision.

There is now no doubt that, in districts where peat is plentiful and coal is dear, peat of low ash content can be economically utilised for the manufacture of producer-gas or of semi-water gas. Thus the town of Skabersjo, in Sweden, for the past eleven years has been supplied with electricity for illumination and power purposes by a high-voltage current transmitted from a bog three miles from the town, where it is generated in dynamos driven by engines supplied with semi-water gas made from machine-turf in a suction power-gas producer of the Koerting type. A horse-power hour requires about 4½ lb. of air-dried turf, which at the power station costs less than four shillings per ton. Similarly at Visby, turf costing about five shillings per ton is converted into semi-water gas and employed to drive the machinery of a cement works.

Apart from its use as moss-litter, peat can be economically employed as a fuel in the immediate neighbourhood of a moor, or on a larger scale it can be converted with advantage into producer-gas, the latter serving as fuel for the manufacture of substances such as glass, or into semi-water gas for power purposes, like that for which it is utilised at Visby.

[1] Wisconsin Geological and Natural History Survey. Bulletin No. xlv Economic Series No. 20. The Peat Resources of Wisconsin. By F. W. Huels. Pp. xvii+274. (Madison, Wis.: Published by the State, 1915.)

THE OXIDATION OF DRYING-OILS.

MUCH attention is now being paid to the scientific aspects of the phenomenon of "drying" whereby, for instance, boiled linseed oil on exposure to the air is converted by oxidation into a hard varnish-like product. The experiments by which Dr. R. S. Morrell was able to isolate a crystalline component from a drying-oil (Trans. Chem. Soc., 1912, vol. ci., 2082), namely, by the action of light upon Hankow "Chinese wood oil," have already been noted in these columns. A further advance is recorded in a paper by Dr. A. H. Salway, which has recently appeared in the Chemical Society's Journal (vol. cix., pp. 138–45). This investigator has oxidised linseed oil by shaking it with oxygen at 100°, and trapping the volatile products in a wash-bottle containing water. Not only was the odour of acrolein, $CH_2:CH\cdot CHO$, observed, but the solution showed the chemical reactions of an aldehyde, and on shaking with silver oxide gave a sufficient quantity of silver acrylate, $CH_2:CH\cdot CO\cdot OAg$, for identification by estimation of the silver contained in it.

Since acrolein is easily produced by the dehydration of glycerine, it has usually been assumed, when the odour of this compound has been detected, that it was derived from the glycerine of the glycerides which constitute the drying-oil. This assumption has been disproved in the present instance, since acrolein was also obtained by oxidising in a similar manner the free fatty acids obtained by hydrolysing the oil, as well as by oxidising the linolenic acid which is the chief product of this hydrolysis. No acrolein was formed in the oxidation of oleic acid, and it is doubtful if linoleic acid would give any acrolein if it could be obtained quite free from linolenic acid.

In order to explain these observations, it is suggested that linolenic acid contains three copulated double-bonds, of which the two outer ones only would unite with oxygen to form an oxygenide, and then rupture with formation of pairs of aldehydic groups, thus—

(1) $-CH{=}CH-CH{=}CH-CH{=}CH-$

(2) $-CH-CH-CH{=}CH-CH-CH-$ (the first pair and the last pair of CH groups each bridged by O——O)

(3) $-CHO \mid CHO-CH{=}CH-CHO \mid CHO-$ (fumaraldehyde)

(4) $CO+CH_2{=}CH{\cdot}CHO$ (acrolein) (5) $CHO{\cdot}CHO+CHO.CHO.$

The hexatriene group would thus give rise to fumaraldehyde, from which acrolein could be produced by removal of carbon monoxide (or by oxidation with removal of carbon dioxide), whilst oxidation of the double-bond would give rise to glyoxal, $CHO{\cdot}CHO$. It is suggested that this formation of aldehydes by oxidation is an essential feature of the process of drying, and that the varnish-like product, to which the name linoxyn has been given, is essentially a mixture of polymerised aldehydes, including polymerisation products of acrolein and glyoxal.

It is an encouraging sign of the times that investigations such as these should be undertaken by important commercial companies, as a normal part of the work of their research laboratories; no better omen could be discovered for the stability of British chemical industries in face of the severe competition which may be anticipated in the near future. T. M. L.

INDUSTRIAL RESEARCH IN THE UNITED STATES.[1]

WHILE research is receiving increasing recognition as an essential factor in industrial work, little attention has been given to the manner in which scientific resources in this country can best be directed to meet national industrial needs. A description of the manner in which the United States is dealing with this matter may be useful in throwing some light on our problem, and incidentally the evidence of the progress in that country of industrial research may be inspiring to English manufacturers, who are somewhat sceptical as to the value of science in industry.

The term "industrial research" is often very loosely applied, and it is necessary first of all to define what it really comprises. One may consider it to be focussed in a simple fundamental principle that an industry depends for progress on a continual influx of new knowledge, and it may be conceived that industrial research embraces all means whereby this new knowledge having application in industry can be obtained, whether it is from the accumulated experience of individual workers, or from the efforts of trained investigators directing their efforts to the solution of manufacturing problems impeding the progress of industry, requisitioning where necessary the aid of contemporary science; or whether from new discoveries resulting from investigations in pure science which ultimately find their application in industry.

Industrial research in the United States is mainly accomplished by individual firms, although a good deal is done in the universities and national institutions. With certain exceptions, noted later, the greater part of the university work, however, is directed to pure science investigations having no immediate commercial object.

As regards the work of individual firms, during the past ten years there have been very considerable sums spent by the leading manufacturing corporations to provide facilities for scientific investigation. Annual expenditures for this purpose of 25,000*l.*, 50,000*l.*, and even 100,000*l.* are not uncommon. The leading firms possessing private research laboratories include the General Electric Co., Schenectady; Westinghouse Electrical and Manufacturing Co., East Pittsburg; Eastman Kodak Co., Rochester, New York, this firm representing the manufacture of photographic chemicals and apparatus; the Du Pont Powder Co.; the American Rolling Mill Co., producing sheet iron and steel; the National Electric Lamp Association, representing a large number of electric lamp manufacturers; the General Chemical Co.; General Bakelite Co.; United States Steel Corporation; the Edison Laboratories; Pennsylvania Railway Co., which deals with all kinds of materials and investigations pertaining to railway requirements; and many others.

Among the important features of the work of many of these laboratories is the equipment of full-scale manufacturing plant, which enables discoveries in the laboratory to be fully tried out and manufacturing methods perfected, relieving the manufacturing departments from the hampering effects of new developments. Many of the laboratories also are equipped for the manufacture on a commercial scale of some of the commodities developed from their discoveries which are not of a character adapted to production in the manufacturing departments. The laboratory production in such cases is continued until it reaches such dimensions as justify the starting of a separate works. There is a growing tendency in many of the research laboratories to devote more and more attention to investigations in pure science having no immediate commercial object in view, with an appreciation of the fact that almost invariably such investigations result in industrial application, sometimes bringing about the development of entirely new industries. Prominent examples of this kind are represented by the work of the General Electric Co.'s laboratory at Schenectady and the National Electric Lamp Association. In connection with such work, a very broad-minded policy is shown by the publication of the scientific investigations carried out.

It is also noteworthy that these research laboratories serve as very effective advertising means by inspiring confidence in the minds of purchasers as a result of such visible evidence of scientific working.

There appears to be no doubt that these laboratories have proved financially successful, not only in that they afford the greatest possible assistance to the works with which they are connected in solving manufacturing troubles, developing new materials, methods, tools, and making discoveries which result in new industrial developments, but also in the direct manufacture and

[1] Synopsis of an address delivered before the Engineers' Club, Manchester, at the Municipal School of Technology, on April 4, by A. P. M. Fleming.