years of a devastating world war, and in this task of extending our knowledge of pure science and its application to the whole field of industry the Imperial College is called upon to play a vital and predominant part.

The recognition of how great and important are the responsibilities thus cast upon the Imperial College has led to a movement for obtaining for the college the status of a university with the power to confer degrees in its own subjects or faculties. The movement is backed by the unanimous support of the rector and professors of the Imperial College, and it is supported, so far as can be ascertained in any organised way, by the overwhelming majority of the past and present students of the college. The issue raises, no doubt, questions that are novel and complicated in relation to university education in general and to the University of London in particular. Nothing but good can come from a free and frank examination of the proposition in all its bearings, undisturbed and unprejudiced by lesser interests than that of increasing the efficiency of university education and especially of scientific education.

Magnetic Disturbances and Geological Structure.[1]

THE research described in the report before us was undertaken at the instigation of the Iron Ores Committee of the Conjoint Board of Scientific Societies. Certain lines and centres of magnetic disturbance had been noted in Britain so long ago as 1890 by Rücker and Thorpe, and a new magnetic survey by Mr. G. W. Walker in the years 1914 and 1915 confirmed the existence of these disturbed areas. It is well known that iron is the only element which gives rise to magnetic effects of considerable intensity, and it was therefore of importance to determine whether any relationship could be established between the location of these disturbances and the distribution of iron ores.

The detailed magnetic survey of (1) the proved sheet of iron ore, mainly in the state of ferrous carbonate, round Irthlingborough, and (2) the known areas of magnetic disturbance about Melton Mowbray, was therefore undertaken by Mr. Walker. At the same time, Dr. Cox reviewed the geology of the areas and collected specimens of rocks which promised to afford evidence in the matter, while the magnetic susceptibilities of these materials were determined by Prof. Ernest Wilson.

The results of the magnetic and petrological examination of the rocks confirm the opinion that the magnetic susceptibility of rocks depends scarcely at all upon the percentage of metallic iron they contain, but upon the condition—*i.e.* state of oxidation—of that iron; and that, although rocks composed of ferrous compounds show higher susceptibilities than those constituted of fully oxidised ferric compounds, only those rocks in which the iron occurs as the mineral magnetite have notable magnetic susceptibility. It was shown that parts of the granite of Mount Sorrel have a susceptibility more than four times as great as that of the most magnetic of the local Jurassic iron ores, and ten to fifteen times as great as certain basic igneous rocks, which, though high in iron, contain no appreciable amount of magnetite.

Another point of some interest is the variability of magnetic properties shown by samples taken from one continuous rock mass. The outer part of the dolerite sill proved in the Owthorpe borehole was a fine-grained rock having a glassy base; its iron ore occurs as magnetite, and the magnetic susceptibility of the specimen examined was 472×10^{-5} C.G.S. units. The coarse-grained rock from the centre of the intrusion, however, in which the iron ores crystallised as ilmenite, gave a susceptibility of only $10{\cdot}3 \times 10^{-5}$ C.G.S. units. A like low susceptibility was noted also in the basalt from the Southwell borehole.

The magnetic phenomena of the Irthlingborough district are adequately explained by the presence of such a large, flat-lying sheet of feebly magnetic rock as the Bajocian iron-ore bed, but in the Melton Mowbray district the proved limits of the marlstone iron-ore bed bear no relation to the observed magnetic phenomena. Moreover, the consideration of the magnetic irregularities obtained in the Melton Mowbray district shows that the source of the disturbance cannot be less than 3000 ft., and may be as much as 10,000 ft. beneath the surface. The only rocks in this region which have the requisite magnetic susceptibility and may be expected to occur at these depths are dolerites, such as are found intrusive into the Coal Measures throughout the Midland coalfield area, or possibly granites like those which have invaded the old pre-Carboniferous rocks in Charnwood Forest.

Mr. Walker's observations show that, near to Melton Mowbray, there are two main magnetic disturbances, and that the line joining them ranges north of west and south of east from Melton Mowbray towards Rempstone, passing a little south of the latter place. This line agrees with that of a known fault of small throw which cuts the Mesozoic rocks, and may be expected to have a much larger throw in the Palæozoic and older strata underground. Similar magnetic disturbances are noted near certain large faults in the Nottingham district. Rücker and Thorpe showed that magnetic disturbances are always to be expected where a sill or dyke of highly susceptible rock is displaced by a fault, and that, if any rock containing magnetite is intruded as a dyke among non-susceptible rocks, similar magnetic disturbances must occur. It is known that in many districts the place of intrusions has been determined by faulting, and it is pointed out by Dr. Cox that the concealed coalfield of Notting-

[1] "A Report on Magnetic Disturbances in Northamptonshire and Leicestershire and their Relations to the Geological Structure." By Dr. A. H. Cox. Phil. Trans. Roy. Soc., Series A, vol. ccxix., pp. 73–135; plates Ap. i.–Ap. iii.

hamshire should end off at an anticline, probably faulted, in the region about Melton Mowbray. Such an anticline has an east-and-west trend, and carries round the strike of the Coal Measures from its general north-east-and-south-west to an east-and-west direction. The Rempstone-Melton Mowbray magnetic disturbances, therefore, are interpreted as additional evidence of the existence of a fault which in the underlying Palæozoic rocks may have a considerable throw; and it is regarded as probable that a sill of dolerite is displaced by this fault, or that an irregular mass of dolerite is intruded along it.

The hope is expressed by the author that a like method of attack may prove to be of use as a guide to the divining of the position of faults beneath a cover of unconformable strata in other districts—*e.g.* in concealed coalfields, where dolerites or other rocks containing a high proportion of magnetite are present. Unfortunately, however, or fortunately from the point of view of the coal miner, dolerites are not an invariable concomitant of coal seams, and it therefore follows that the use of the method in determining the limits of concealed coalfields would appear to be somewhat restricted.

British Crop Production.[1]

By DR. EDWARD J. RUSSELL, F.R.S.

CROP production in Britain is carried on in the hope of gain, and thus differs fundamentally from gardening, which is commonly practised without regard to profit and loss accounts. Many poets from times of old down to our own days have sung of the pleasures to be derived from gardening. But only once in the history of literature have the pleasures of farming been sung, and that was nearly two thousand years ago.

Ah! too fortunate the husbandmen, did they but know it, on whom, far from the clash of arms, earth their most just mistress lavishes from the soil a plenteous subsistence.—"Georgics," Bk. II., i., 458 *et seq.*

"Did they but know it"! Even then there seem to have been worries!

This seeking for profit imposes an important condition on British agriculture: maximum production must be secured at the minimum of cost. This condition is best fulfilled by utilising to the full all the natural advantages and obviating so far as possible all the natural disadvantages of the farm—in other words, by growing crops specially adapted to the local conditions, and avoiding any not particularly well suited to them.

From the scientific point of view the problem thus becomes a study in adaptation, and we shall find a considerable interplay of factors, inasmuch as both natural conditions and crop can be somewhat altered so as the better to suit each other.

It is not my province to discuss the methods by which plant-breeders alter plants; it is sufficient to know that this can be done within limits which no one would yet attempt to define. The natural conditions are determined broadly by climate and by soil. The climate may be regarded as uncontrollable. "What can't be cured must be endured." The scheme of crop production must, therefore, be adapted to the climate, and especially to the rainfall.

The rainfall map shows that the eastern half of England is, on the whole, drier than the western half. In agricultural experience, wheat flourishes best in dry conditions and grass in wet conditions; the vegetation maps show that wheat tends to be grown in the eastern and grass in the western part. The strict relationship is that seed production is appropriate to the drier, and leaf production to the wetter, districts.

The great soil belts of England south of the Trent run in a south-westerly direction; north of the Trent, however, they run north and south. A heavy soil, like a wet climate, favours grass production; a light soil, like a dry climate, is suitable for arable crops. The great influence of climate is modified, but not overridden, by the soil factor.

The arable farmer grows three kinds of crops: corn, clover or seeds hay, and fodder crops for his animals or potatoes for human beings. The same general principles underlie all, and as corn crops are of the most general interest (though not necessarily of the greatest importance), they will serve to illustrate all the points it is necessary to bring out. We have seen that wheat is cultivated more in the eastern than in the western portion of the country. The figures for consumption and production are as follows:—

Millions of Tons per Annum.

	Consumption in United Kingdom	Production in England and Wales			Production in United Kingdom		
		Before war 1914	1918	1919	Before war 1914	1918	1919
Wheat ...	7·40	1·6	2·3	1·8	1·7	2·0	2·0
Barley ...	1·96	1·2	1·2	1·1	1·6	1·5	1·3
Oats ...	4·30	1·4	2·0	1·6	3·0	4·5	4·2

During the war very serious attention was paid to the problem of reducing the gap between consumption and production. A working solution was found by lowering the milling standard, retaining more of the offal, and introducing other cereals and potatoes; a very considerable proportion of the resulting bread was thus produced at home. But the war-bread did not commend itself, and disappeared soon after the armistice; since then the consumption of wheat has gone up, and the divergence between consumption and production has again become marked. There is no hope of reducing consumption; we must, therefore, increase production. Additional production may be obtained in two ways: by increasing the yield per acre, and by increasing the number of acres devoted to the crop.

The yield per acre is shown in the following table:—

Measured Bushels per Acre.[2]

	(1908–17) Average yield per acre			
	England and Wales	Scotland	A good farmer expects	Highest recorded yield
Wheat ...	31·0	39·9	40 to 50	96
Barley ...	31·9	35·4	40 to 60	80
Oats ...	39·3	38·9	60 to 80	121

The average results include bad farmers and bad seasons; the good farmer expects to do considerably

1 Discourse delivered at the Royal Institution on Friday, February 20.

2 Unfortunately the terms "bushel" and "quarter" (8 bushels) lack definiteness, being used officially in three different senses and unofficially in several others also. The following are some of the definitions of a bushel:—

	Official Statistics. A definite volume having the following average weight	Corn Returns Act. Volume occupied by following weight	Grain Prices Order. Volume occupied by following weight	Frequent Practice. Volume occupied by following weight
	lb.	lb.	lb.	lb.
Wheat ...	61·9	60	63	63
Barley ...	53·7	50	55	56
Oats ...	39·3	39	42	42