

**INTRODUCTION TO THE STUDY OF THE  
SCIENTIFIC PRINCIPLES OF  
AGRICULTURE; BEING THE INAUGURAL  
LECTURE, DELIVERED MAY 6, 1884, AT  
THE UNIVERSITY MUSEUM, OXFORD**

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Introduction to the study of the scientific principles of agriculture; being the inaugural lecture, delivered May 6, 1884, at the University museum, Oxford by Joseph Henry Gilbert

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**JOSEPH HENRY GILBERT**

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INTRODUCTION  
TO THE STUDY OF  
THE SCIENTIFIC PRINCIPLES  
OF  
AGRICULTURE;

BEING  
*The Inaugural Lecture,*

DELIVERED MAY 6, 1884,

AT THE UNIVERSITY MUSEUM, OXFORD.

BY

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# INAUGURAL LECTURE.

OXFORD, MAY 6, 1884.

MR. VICE-CHANCELLOR AND GENTLEMEN,

THE term *Rural Economy*, which gives the title to the Professorship to which I have been appointed, might be held to include such a variety of topics, that if I had no other guide in the selection of subjects to bring before you, I should be placed in a position of some difficulty. It would not be inappropriate to treat of the general management of landed property from the point of view of the Land-owner or the Land-agent; of the practical details of farming, mechanical, economical, and commercial, such as are essential to be observed by the tenant or occupier, if his business is to be a profitable one; or, lastly, attention might be confined to the elucidation of the scientific principles involved in successful practice, so far as the existing knowledge of the day permitted.

Fortunately, however, I have not only the obvious intentions of the Founder of this Chair, the late Professor Sibthorp, and the way in which my Predecessor, the late Professor Daubeny, interpreted and performed the duties of the office, to guide and limit my selection of subjects; but, on the 14th of July last, these duties were, under the sanction of the Chancery Division of the High Court of Justice, defined to be to lecture on the *Scientific Principles of Agriculture*.

It may be not out of place to remind you that, according to Dr. Sibthorp's will, the Sherardian Professor of Botany for the time being was to hold the Professorship of Rural Economy; and that hitherto,

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that is until the settlement by the Court of Chancery last year, the appointment has been so held ; and the obligation was limited to giving one Public Lecture in each term. The new arrangement, however, dissociates the Chair of Rural Economy from that of Botany, and requires that twelve lectures shall be given annually.

Thus my responsibilities are somewhat defined, and they are, at the same time, somewhat limited :—for, how far from a complete system of instruction in all that pertains to Rural Economy can be embodied in a course of twelve lectures may be judged by reference to the course of study laid down in Institutions specially devoted to the training of Students in Agriculture. Thus, the Syllabus of one Agricultural College includes no less than thirty distinct subjects of lecture or other instruction, and the Prospectus of another enumerates sixteen main departments, covering much the same range of subjects as the other ; whilst each Institution has a numerous staff of Professors or Teachers. Again, in one London College a course of forty lectures is annually given on Soils, Manures, Crops, Live Stock, &c. ; and in another lectures and laboratory instruction are given on Soils, Rotation, Manures, Feeding and Feeding-stuffs, Seeds, &c.

It is not then, I take it, expected of me that I should undertake to impart that systematic instruction in the various branches of the art and the science of Agriculture, which it is desirable the student who intends to devote himself to the details of practical farming, whether as agent or occupier, should receive. I assume that those studying at this University will for the most part be interested in land either as Owners, or as Clergymen in rural districts, or it may be as Statesmen, and that it should be my endeavour so to inculcate general principles as to train the

observation, and give a direction to the reflections, of those who hear me, and to enable, and it may be to stimulate them, to study further for themselves, as problems requiring it may come before them.

What then is Agriculture—the scientific principles of which we have to investigate? Discarding the mere etymological meaning of the term, and giving it the wider signification accorded to it by long usage, it is the art by which animal as well as vegetable products are obtained from the land.

Natural vegetation, as in the case of prairie-lands, for example, does indeed contribute food to the lower animals, and through them food and other products for the use of man; but the result is attained with little of his aid which can come under the definition of Agriculture.

But the practices by which vegetable and animal products are obtained from the land in settled countries differ essentially from those above alluded to, and it is these to which our attention must mainly be directed. Such Agriculture implies the growth of other plants than would be obtained under conditions of natural vegetation, and the growth of more produce over a given area than would be so obtained. It implies, in fact, what may be called concentrated production.

Agriculture, the oldest of the arts, was in methods at first purely mechanical; though, as we now know, the results to be attained were largely chemical. When manure was first applied to the soil, that is when the refuse of previous crops, or the excrements of animals, were first returned to the land as a means of increasing the growth of succeeding crops, directly chemical means—the supply of material—were first adopted.



Professor Daubeny, in his lectures on Roman Agriculture, quotes Cato as having said—

‘If I am asked, what is the first point in good husbandry, I answer, good ploughing ; what the second, ploughing of any kind ; what the third, manuring.’

We have thus evidence of the relatively little esteem in which manuring was held in Italy two thousand years ago ; and in the fact that so much more value was set upon the mechanical operations we have evidence that the resources of the soil itself were far from being exhausted, and only required such means to be taken to render them available.

There is nevertheless evidence that, long before the time of Cato, it was sought to restore fertility to the soil by practices the efficacy of which is still fully recognised ; though the explanation of some of the phenomena involved is still a matter of controversy. Such, for example, was the growth of various crops of the Leguminous family, sometimes to be in great part removed, but in others to be at once ploughed into the land, by either of which methods the growth of succeeding crops was enhanced. This subject will receive detailed consideration further on.

But although manuring, in various ways, has thus been so long recognised as desirable, it is in fact only in quite recent times that the rationale of such practices could be at all satisfactorily explained. To this end it was obviously essential not only to know the composition of the vegetable products grown, but something of the sources of their various constituents—whether these must be derived from the soil, or whether from the atmosphere, or from water ?

What then is the composition, and what are the sources of the constituents of vegetable products ?

When a vegetable (or animal) substance is burnt,

the greater part of it is dissipated, but there remains a white ash. This ash is found on analysis to contain most or all of the constituents enumerated in the first column of the following Table.

*Constituents of Plants and Animals.*

INCOMBUSTIBLE OR FIXED.	COMBUSTIBLE OR VOLATILE.
Iron. (Manganese). Lime. Magnesia. Potash. Soda. Phosphoric acid. Sulphuric acid. Chlorine. Silica.	Carbon. Hydrogen. Oxygen. Nitrogen.
Sulphur. Phosphorus.	

Rarer substances than these are also sometimes found. It will be my duty, in subsequent lectures, to call your attention in some detail to what is known as to the occurrence, and the offices, of the various mineral or ash-constituents in plants. It will suffice here to say, that the ash of one and the same description of plant, growing on different soils, may, so long as it is in the vegetative or immature state, differ very much in composition. Again, the ashes of different species, but growing on the same soil, will differ very widely in the proportion of their several constituents. But it is found that the nearer we approach to the elaboration of the final products of the plant—the seed for example—the more fixed is the composition of the ash of such products of one and the same species. In other words, there is very

little variation in the composition of the ash of one and the same description of seed, or other final product, provided it be evenly and perfectly matured. This fact alone, independently of what has been established of late years in regard to the office or function so to speak of individual mineral constituents of plants, would be sufficient to indicate the essentialness of such constituents for healthy growth.

Th. De Saussure, in his work entitled, 'Recherches sur la Végétation,' published in 1804, gave the results of the analyses of many plant-ashes, maintained the essentialness of the ash-constituents, and pointed out that they must be derived from the soil. He also called attention to the probability that the incombustible constituents so derived by plants from the soil were the source of those found in the animals which fed upon them.

Yet such was the prevailing uncertainty on the point, that Sir Humphrey Davy, in his lectures delivered not long afterwards, deemed it not inappropriate to combat the idea that the earths found in plants had been formed from any of the elements existing in the air, or in water. After quoting the results of an experiment of his own, in which he attempted to grow oats without any supply of silica beyond that contained in the seed sown, and referring to the experiments of De Saussure, he says:—

'As the evidence on the subject now stands, it seems fair to conclude, that the different earths and saline substances found in the organs of plants are supplied by the soils in which they grow; and in no cases composed by new arrangements of the elements in air or water.'

It is no longer doubted that the mineral or ash-constituents of plants must be provided within the