



The Nature of Agriculture (I)

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The Nature of Agriculture

The art of agriculture holds a unique place in this world. It is the first art of civilisation ; first both in time and in importance. To begin with, it is necessary for the continuance of human life itself. Except under the most primitive conditions, humans could not get enough food to survive without resorting to this art. The primitive arts of subsistence, which may have preceded agriculture, are capable of supporting very few, and widely scattered peoples, even under the most favourable conditions. It is estimated that for one family to subsist by hunting alone, an area of ten to fifty square miles of virgin wilderness is required.¹ People who live pastoral lives wander hundreds, even thousands, of miles to find pasture for their animals. And, given the most favourable conditions, a life lived by hunting or herding is hard, cruel and hasardous. People who follow these modes of life are always forced to supplement the meager and uncertain returns which they give with some agriculture, or by plundering their wealthier neighbors.

But agriculture is even more necessary for a civilized life. By this art alone can humans acquire enough food and other necessities, in the abundance, variety, and with the regularity required for civilized life. Without this abundance men could not live together in numbers large enough for a political community ; nor could they live together peacefully, which is also a condition for political life. Friendship, the bond of political life, cannot be cultivated when people are widely separated from each other. The abundance of food which agriculture produces also makes it possible for many members of the community to devote their energies to other pursuits ; and the first of these are the other practical arts, by which other goods are produced for the community.² Many of the earliest arts arose to minister to the needs of agriculture itself, such as the making of agricultural instruments. Moreover, the surplus of agricultural products is the first foundation of trade and commerce, by which more goods are brought into the community, thus helping to make it more self-sufficient, and capable of political life.³ And, finally, the surplus of goods permits some members of the community to be freed from the pursuit of wealth, and to be permitted to pursue the work of free men, such as the arts of defence and of governing, and even the

1. SEARS, Paul, *Deserts on the March*, Norman, Oklahoma, Univ. of Oklahoma Press, 1947, p.4.

2. ST. THOMAS, *In I Politicorum*, lect.6 : "et isti habent cibum elaboratum." — HOWARD, Albert, *The Soil and Health*, New York, Devin Adair, 1945, p.33, "Until man had learned to add the cultivation of plants to his knowledge of hunting and fishing he could not emerge from his savage condition."

3. ST. THOMAS, *op. cit.*, lect.7.

pursuit of truth or science. For these reasons agriculture is called the mother of all the arts of civilized life ; a notion which is well expressed in the words of Daniel Webster : " When tillage begins other arts follow. The farmers therefore are the founders of human civilization."

Not only has civilization risen and flourished when agriculture has flourished, but civilization has declined when agriculture has declined or been abandoned. The oldest uninterrupted civilizations, those of Egypt, China and India, are also the ones which have a permanent and vigorous agriculture, as old as the civilizations which it has made possible. The Chinese people attribute divinity to the Emperor Shon-nung (2,700 B.C.), " who cleared the land and taught the people to sow crops, and thus saved them from the hardships of the chase." The subsequent emperors were, themselves, expert farmers, and many of them plowed their own fields. The development and improvement of agriculture became the main function of their government, which maintained a large department of agricultural experts, and enforced many agricultural laws.¹ In Ancient India, according to Megasthenes, a farmer could not be arrested during harvest time ; and in the time of war, the farmer, his work and his crops were left unmolested.²

In contrast to the East, Africa never succeeded in establishing a permanent agriculture. Albert Howard says : " It may be observed here that the great misfortune of the African continent has been that it never came in contact with the agricultural peoples of the Far East and never revised its systems of cultivation in the light of the knowledge it might thereby have gained — the great lesson of the Nile basin was not truly apprehended and has had no influence outside Egypt, whereas over large parts of eastern Asia the central problem of agriculture was solved early, empirically and not by a process of scientific investigation, yet with outstanding success." ³

In the West, the story of agriculture is quite a different one. Both the Greeks and the Romans recognized that the strength and vigor of their nations was founded on the agriculture of a sturdy peasantry. In *The Economist*, Xenophon praises agriculture unstintingly, as the matrix of the other arts, the fountainhead of plenty, a school of virtue, and the source of many wholesome pleasures :

All this I relate to you, continued Socrates, to show you that quite high and mighty people find it hard to hold aloof from agriculture, devotion to which would seem to be thrice blest, combining as it does a certain sense of luxury with the satisfaction of an improved estate, and such training of physical energies as shall fit a man to play a free man's part. Earth, in

1. SOROKIN, P., ZIMMERMAN, C., and GALPIN, C., *A Systematic Source Book in Rural Sociology*, Minneapolis, University of Minnesota Press, 1930, Vol. I, pp.10-30. Also KING, F. H., *Farmers of Forty Centuries*, London, Jonathan Cape, 1926.

2. SOROKIN, ZIMMERMAN and GALPIN, *loc. cit.*

3. HOWARD, Albert, *The Soil and Health*, New York, Devin Adair, 1945, p.38.

the first place, freely offers to those that labor, all things necessary to the life of man ; and as if that were not enough, makes further contribution of a thousand luxuries . . .

Yet she suffers not her gifts to be received effeminately, but inures her pensioners to suffer gladly, summer's heat and winter's cold . . .

For myself, I marvel greatly if it has ever fallen to the lot of freeborn man to own a choicer possession or to discover an occupation more seductive, or of wider usefulness than this . . . But furthermore earth, of her own will gives lessons in justice and uprightness to all who can understand her meaning, since the nobler the service of devotion rendered, the ampler the riches of her recompense. One day perhaps, these pupils of her whose conversation in times past was in husbandry, shall by reason of the multitude of invading armies be ousted from their labors. The work of their hands may indeed be snatched from them, but they were brought up in a stout and manly fashion. They stand, each one of them in body and soul equipped ; and save God himself shall hinder them, they will march into the territory of those their human hinderers, and take from them the wherewithal to support themselves.

But there is another lesson to be learned in the public school of husbandry — the lesson of mutual assistance. "Shoulder to shoulder" we march to meet the invader ; "shoulder to shoulder" stand to compass the tillage of the soil . . .

It was an excellent saying of his who named husbandry the "mother and nurse of the arts" for while agriculture prospers all other arts are vigorous and strong, but when the land is forced to remain desert the spring that feeds the other arts is dried up ; they dwindle, I had almost said one and all, by land and sea.¹

The general tenor of these views on agriculture, either in whole or in part, is to be found in many Greek and Roman writers. Hesiod, Aristotle and Polybius are among the Greeks ; and, among the Romans, Cato, Varro, Cicero, Sallust, Horace, Columella, Palladius (who is mentioned by St. Thomas), Seneca, Lucan, Tacitus, and others. Virgil laments the destruction of farming, and the lack of respect for it, as the people abandoned it for city life and military careers. Sharpest of all the writings on the decline of Roman agriculture, perhaps, are those of Columella, at the time when peasant agriculture was being widely replaced by cattle raising and by slave-operated plantations :

. . . All we who are masters of families, having abandoned the pruning hook and the plough, have in a sneaking manner, crept within the walls, rather move our hands in the circus and the theatre, than in the cornfields and vineyards : . . . Now we disdain and think it below us to live upon and cultivate the land ourselves . . . But whether he be a rich man that purchases a piece of ground, he picks out of his crew of footmen and chairmen, one that is the feeblest and most worn out with years, and banishes him to the country ; whereas that business requires not only knowledge

1. SOROKIN, ZIMMERMAN and GALPIN, *op. cit.*, pp.37-39.

but green age and strength of body . . . or if he be a master of a middling estate, he commands one of his hirelings (who cannot serve him otherwise) to be director and overseer, who is ignorant of the business he is to have the oversight of.

I frequently hear the principal men of our city blaming, sometimes the unfruitfulness of the ground, at other times the intemperateness of the weather, as hurtful to the fruits of the earth. . . . Which causes, Publius Silvanus, I am convinced, are far from the truth ; because it is neither lawful to think, that the nature of the ground, which the original Farmer and Father of the universe endowed with perpetual fecundity is affected with barrenness as with a certain disease ; . . . but rather from our own fault, who commit our husbandry to the very worst of our servants, as a criminal to the public executioner, which all the best of our ancestors were wont to treat with the greatest gentleness : . . .¹

"The strength of man and of the state," says Mommsen, "lies in their dominion over the soil ; the strength of Rome was built on the most extensive and immediate mastery of her citizens over the soil, and on the compact unity of the body which thus acquired so firm a hold." ²

Thus the land which had so long supplied the food and the citizens for Rome's greatness declined gradually to a barren and desolate condition. A few years ago, says Howard, "it was possible to see on a mere day's excursion away from Rome a wild shepherd tending his sheep over a ruined countryside which might have been carved out of the most ancient wilderness, so entirely denuded was it of all traces of tillage or of the care of man." ³ In the time of the Empire, much of Rome's food had to be imported from the then fertile North Africa, Egypt and the regions of the Black Sea.

North Africa has long since become barren, and a similar fate has happened to Persia, Mesopotamia, Palestine and other ancient nations. Reviewing this story, Paul Sears says :

Man's own past is full of clear and somber warnings — vanished civilizations buried like flies in lacquer, beneath their own dust and mud . . .

For man, who fancies himself the conqueror of it, is at once the maker and the victim of the wilderness. Even the dense and hostile jungles of the tropics are often the work of his hands . . .

The virgin forests of the tropics are no thicket of scrub and thorn, but a cathedral of massive, well spaced giant trees under whose dense canopy the alien and tangled rabble of the jungle does not thrive.⁴

Thus far, the short history of agriculture in the western hemisphere, in Australia and in South Africa, has been a prodigal one, as

1. SOROKIN, ZIMMERMAN and GALPIN, *op. cit.*, pp.46-49.

2. HOWARD, Albert, *An Agricultural Testament*, p.7.

3. HOWARD, Albert, *The Soil and Health*, p.40.

4. *Op. cit.*, p.5.

the whole chorus of writers on the subject repeat in unison. Says Sears :

Wherever we turn to Asia, Europe or Africa, we find the same story repeated with an almost mechanical regularity. The net productiveness of the land has been decreased, fertility has been consumed and the soil destroyed at a rate far in excess of the capacity of either man or nature to replace. The glorious achievements of civilization have been built on borrowed capital to a scale undreamed of by the most extravagant of monarchs.¹

The question arises whether this course of things is inevitable. If it is, then the end of all civilization is already in sight. Hugh Bennett, of the United States Soil Conservation Service, has said : " This nation and civilization is founded on nine inches of topsoils, and when that is gone there will no longer be any nation or civilization." But, to read these authors, such a result is in no sense inevitable. Chinese agriculture, and that of many parts of India, as well as the agriculture of many smaller groups throughout the world, offer a host of examples to the contrary. It is not nature that is wanting in the matter, even though nature be unable to do the work single-handedly. Rather, it has been the ignorance, the negligence or the greed of humans which has caused the trouble. Now, there is no longer any reason for ignorance, nor any room for negligence or greed. The story of Japanese agriculture is an excellent example of a land where these three factors have been kept at bay.

The true peasantry, the founders of the permanent agriculture of past and present times, did not know the real causes of their successful practices. These causes are rapidly being made known by science. But they did possess the first requisites for good farming ; that is, a sense of stewardship of the soil which they worked, a willingness to be guided by nature's laws as manifested by signs, and a respect for practices which are sanctioned by long experience. This kind of peasantry, says Ehrefried Pfeiffer, is on the point of disappearing :

Looking back over the course of the last few centuries we can follow its decline step by step. Old traditional customs are no longer understood and practiced. The whole attitude has changed. In times gone by, after a week of hard work, the farmer used to walk through his fields on Sunday. His heavy swinging gate . . . betokened his train of thought. It expressed a deep penetration into the processes of nature. On these Sunday walks, the creative work of the week was thought over in terms almost to be compared with the biblical epic of creation.

The farmer was often accompanied by his son, whom he initiated into the mysteries of nature. He described to him in simple words the manner

1. *Ibid.*, p.9. For the whole story, cf. HYAMS, E. J., *Soil and Civilization*, New York, Thames and Hudson, 1952 ; and OSBORN, Fairfield, *Our Plundered Planet*, Boston, Little Brown, 1948.

of tilling the earth, the art of sowing. These experiences had been handed down from his forefathers from time immemorial. Other rules did not exist; experience alone was his guide. From observation and tradition the farmers were able to use the course of nature as an almanac with signs and symbols. . . . This instinctive certainty of the old time farmer prompted him to take the necessary measures at the right moment by observing nature's course. This instinct has been lost. An uncertainty has arisen and now the successful neighbor is often the only guide for the farmer's work.

Scientific agriculture has decidedly altered the way of ancient peasantry. It has told the farmer to abandon his old superstitions; that he can obtain better results by turning his fields into a growth factory. The economic development of the 20th century has transformed the farmer into the agriculturist who has to calculate costs and output. Concepts such as "profitableness" born of the decline of the old agricultural tradition, have become his "daily bread" . . .

Although the farmer was told that by means of scientific methods he could double his yield, the fact remains that after years of scientific help, present century farmers are discovering that their "double yields" today are no better than the single yields of previous years . . .

Unfortunately modern science has developed no exact rules to take the place of the old farming wisdom . . . The farmer has constantly to complain of the uncertainty of his crops. . . .

Development, under the pressure of profitableness has forced him to resort to the use of machinery to replace the more expensive hand labor . . . The machine age has brought great changes to the work of the men whose business it is to till the soil. It has created the "growth mechanic" type of farmer. This age has also seen the ever increasing use of mineral fertilizers . . . The situation today shows that while in comparison with the time prior to the war, three times as much nitrogen is being used, the average yield per acre has not increased. In some areas it has actually decreased. Yet the idea that there may be an uneconomical principle underlying the fertilizing methods now in use is often considered heretical. Another problem of the times is the increase in the phenomena of degeneration — plant diseases and insect pests. A description of these phenomena is not necessary, for they are part of the farmer's daily experience.¹

The problem of establishing a permanent and sound agriculture is more than a technical one; and it is more than to obtain the blessing of a true peasantry. In the final analysis it is a social and a political problem. The unprecedented increase in the world's population in our times puts an inexorable pressure on the soil's fertility. Vastly increased yields are necessary. Moreover, modern industry demands a large portion of the farmer's produce for industrial fibers; which means that a large portion of the land is withdrawn from the production of food at a time when many more mouths are to be fed. And these difficulties are compounded by the fact that a greatly increased per-

1. PFEIFFER, Ehrenfried, *Bio-Dynamic Farming and Gardening*, New York, Anthroposophic Press, 1938, pp.1-5.

centage of people live in urban centers. Many harmful effects have followed from this shift in population pattern.¹ For one thing, it means that the working population of the soil is decreasing at a time when the work to be done is increasing. In return, the farmer receives from the town, machinery for his farm and conveniences for his home. But these are costly in terms of cash. To make this cash he must produce in large and regular quantity, and to do this means increased machinery. It becomes a vicious circle, from which the farmer is usually saved by costly subsidies. For another thing, it means that the fertility of the soil, in the form of agricultural products, is removed from the land and funneled into the urban centers, without any corresponding return (except in the form of chemical fertilizer). Rather, the organic wastes of the towns are dumped into the rivers and seas, to pollute and destroy aquatic life, and to accelerate flooding.² Finally, the predominance of urban standards and customs has invaded rural life, so that the farmer is no longer satisfied with his own way of life. The kind of life that he and his family lead is no longer compatible with the way he makes his living.³ This is a situation that is almost contrary to nature itself ; for, as St. Thomas says, the lives men lead are determined primarily by the way in which they get their food.⁴

Because the lives men lead are primarily determined by the way they get their food ; and because the character of men is primarily determined by the lives they lead, agriculture is also judged by its moral effects as well as for the food it supplies. Agriculture not only supplies food to the community, it also supplies it with citizens. From ancient China and India until our own times, the importance of the farming class as citizens has been appreciated, as the opinions cited above reveal ; in the first place because agriculture is a mode of life appointed by nature.

It is the first obligation of man to cultivate the earth, because only by so doing will it provide him with the things he needs ; and furthermore, only by this means will the adornment of the earth be completed, and the evidence of man's mastery over it be manifested.⁵

In the Encyclical *Rerum Novarum*, Pope Leo XIII says :

For that which is required for the preservation of life and for life's well-being is produced in great abundance by the earth, but not until man

1. These problems are the special concern of the Decentralists and Distributists. Cf. ROPKE, Wilhem, *The Social Crisis of Our Time*, Chicago, University of Chicago Press, 1950. Also BELLOC, Hilaire, *The Restoration of Property, et al.*

2. SEARS, *op. cit.*, ch.12, *Wet Deserts*. Also, cf. MUMFORD, Lewis, *Techniques and Civilization*, New York, Harcourt Brace, 1934.

3. Cf. MUMFORD, *The Culture of Cities*, New York, Harcourt Brace, 1928.

4. *In I Politicor.*, lect.6.

5. Cf. BARDET, Gaston, *Demain, c'est l'an 2000*, Paris, Plon, 1952.

has brought it into cultivation and lavished upon it his care and skill. Now when man thus spends the industry of his mind and the strength of his body in procuring the fruits of nature, by that act he makes his own that portion of nature's field which he cultivates — that portion on which he leaves, as it were, the impress of his own personality.

Secondly, because of the special virtues which seem to follow from this kind of life. In the *Politics*, Aristotle gives reasons why the farming class makes the best body of citizens for a democracy. The farmers desire the gains which their own labor produces more than honors ; and for this reason they are not ambitious for offices or rewards. They are satisfied if they have a voice in deciding their rulers ; and they wish to see the best men as rulers, because good rule leaves them free to improve their own lot by their labor. Nor are they prone to envy the wealth or fortune of others, because their labors keep them separate from others and continually occupied. For this reason, also, they do not congregate frequently and give rise to seditions. And, because war threatens their own fields and homes before those of others, they are ready to defend them, and readily become citizen soldiers. Moreover they make good soldiers because their work inures them to long and strenuous activity, and to the hardships of the seasons. The primary reason for the peaceful character of farmers is that they derive their wealth from the fruits of nature itself and not from the labors of other men.¹

Many other moral qualities have been attributed to those who follow agriculture, by the many writers who have praised it.² In our own times it has been recognized as a natural foundation for a strong and wholesome family life. Among other things, farming makes for a stable home life, much more closely knit than others. It is a common enterprise, demanding intelligent cooperation from all the members. Children are in more continual contact with parents and with responsible tasks. Here, also, is a fine opportunity for parents to give to children the moral training which the home affords. Pope Pius XII speaks of the family farm in these words :

Of all the goods that can be the object of private property none is more conformable to nature, according to the teaching of *Rerum Novarum*, than the land, the holding in which the family lives, and from the products of which it draws all or part of its subsistence. And it is in the spirit of *Rerum Novarum* to state that, as a rule, only that stability which is rooted in one's holding makes of the family the vital and most perfect and fecund cell of society, joining up, in a brilliant manner, in its progressive cohesion the present and the future generation.³

1. Book VI, ch.4.

2. Cf. SOROKIN, ZIMMERMAN and GALPIN, *op. cit.*, V.I, pp.143-145.

3. Address of June 1st, 1941.

Accordingly, there can be no greater obligation on any government, save, perhaps, defence, than the protection and the fostering of agriculture. Nor can any modern government be unaware of this obligation. Next to defence, agriculture is the largest and costliest department in many modern governments. In 1943 the United Nations Conference on Food and Agriculture made the following resolutions :

(1) That the conservation of land and water resources should be regarded as an obligation of governments as well as individuals.

(2) That governments should conduct surveys to determine losses of soil due to erosion and other causes, and that conservation measures should be undertaken, based on the results of such surveys.

(3) That governments should assist farmers and operators in rebuilding the fertility of the soil.¹

There are many examples of the things that can be accomplished by well conceived government measures for protecting agriculture. In Denmark, after the Danish Prussian War, a land reform was carried through, the results of which were multiple. It increased the number of small independent farmers so that in 1935 they represented upwards of 80 per cent of the population. The condition of the soil was changed from relative sterility to fertility ; and finally, it brought greatly increased prosperity, and a most even distribution of wealth. It should be noted that this reform was made possible by a movement of spiritual rejuvenation. Another example is had in the successful control of the use of forests in Germany and the Scandinavian countries — a condition which has much to do with the preservation of soil fertility. The work of the United States Soil Conservation Service has been responsible for the restoration of fertility to more than sixty million acres of poor land, and this during the first fifteen years of its existence. The Tennessee Valley Authority was instituted, primarily, to rehabilitate the lives of the rural population of that large and important area. It succeeded, besides, in restoring fertility, arresting erosion and establishing many new industries in that region.²

THE PURPOSE OF THESE PAGES

Our purpose is to determine the nature and first principles of the art of agriculture, in the light of St. Thomas' observations on the subject, namely, to the extent that philosophy considers such things in a rather general way. Our mode of treatment will therefore differ from a special or, to use a current expression, a technical study of the subject, which would get down to particulars and be more practical.

1. *Report of the United Nations Conference on Food and Agriculture, 1943.*

2. LILLIENTHAL, David, *T. V. A. Democracy on the March*, New York, Harpers, 1944.

To explain more clearly the distinction implied we will appeal to St. Thomas' own words in the matter. Aquinas discusses agriculture in his Commentary on the *Politics* of Aristotle. In the Prologue to this treatise he says that, in order to be complete, philosophy must give us some teaching on everything that the human reason can know.¹ And, since the unity which we call civil society is subject to the judgment of reason, a philosophy of civil society should be a part of philosophical knowledge. The first book of the *Politics* treats of the first elements of civil society, which are domestic communities. But wealth, or possessions, are necessary instruments of the domestic community, and so are the arts by which possessions are acquired; now agriculture is primary among these arts. Thus Aristotle treats of it in this place.

Now first philosophy is concerned with the first or universal causes of being; and since all other principles are ultimately reduced to the primary principles, the principles of all other sciences presuppose the principles which philosophy treats of. Philosophy, therefore, directs all the other sciences, as St. Thomas says in the commentary on Aristotle's *Ethics*: "For as the senses which are in the head direct the movements and operations of all the other members, so wisdom directs all the other sciences, since all the others take their principles from it."

Wisdom, simply speaking, is metaphysics, or first philosophy; but the philosophy of nature and political philosophy are spoken of as kinds of wisdom, because they deal with the first principles of nature and of human affairs, respectively. Now agriculture is a practical art, and it is therefore subordinated to political philosophy, which is the supreme science in the practical order, as St. Thomas explains in his commentary on the *Ethics*.² However, in its first principles it is subordinated to the philosophy of nature, because, as St. Thomas points out, it is concerned with acquiring food, which is produced by nature.³

It follows from the above distinction that agriculture can be studied both on a speculative and practical level. It is a practical art but some part of it may be called speculative, as St. Thomas says in his *Expositio in Boethium de Trinitate*.⁴ Yet, the interest that philosophy has, even in a practical art, is speculative. To be more precise about this we will apply the criteria which St. Thomas gives for speculative and practical knowledge.⁵ Knowledge may be called

1. "For everything that can be known by reason, it is necessary that some doctrine be given, for the perfection of human wisdom which is called philosophy."

2. *In I Ethicor.*, lect.2.

3. *In I Politicor.*, lect.8.

4. Q.5, a.1, ad 4.

5. *Summa Theologica*, Ia, q.14, a.16, c.

speculative or practical according to its objects, its mode or its end. The object of speculative science is things not operable by us, and of a practical science things operable by us. From this point of view, agriculture is concerned with operables ; yet not everything about its object is something operable, for the first principles of the art are the natural forces of growth, which, as natural, are not produced by us. The mode proper to a speculative science is resolute, and that proper to a practical science is compositive. The consideration of agriculture in the *Politics* is compositive, for not only is its formal nature treated but also its use, and this is the compositive mode, as St. Thomas describes it. However, since the first principles of agriculture are speculative objects, it is suitable to treat of them in the resolute mode, and St. Thomas' mention of them in the Commentary on Boethius' *De Trinitate* makes use of this mode.¹ Finally, the end is speculative if the study aims at knowing about the subject and practical if it aims at putting knowledge to use. In this respect a philosophical study is always speculative, for it is always too general and remote from practice to be put to immediate use.

In the *Politics*, agriculture and the other arts of acquisition are considered philosophically, both as to their nature and as to their use or practice. Even consideration of their use is speculative in purpose, as we have already indicated ; for philosophy is always concerned with the first or universal principles of things, both speculative and practical. To consider such arts from a practical point of view, St. Thomas says, is outside the aim and scope of the philosopher, for they are not liberal pursuits and special experience is required for their successful practice. In the commentary on the *Politics*, he says :

[Aristotle's treatment of these arts] is divided into two parts. In the first he determines about it insofar as it is science. In the second he determines about it regarding its use.²

After the Philosopher had made known the origin of the arts of acquiring money and their properties and their parts, he now goes on to determine those things which pertain to their use.³

[Aristotle] excuses himself from a complete determination of these matters ; and he says that that which pertains to the use of these arts has now been spoken of ; it will be useful, however, to the activities of those who wish to acquire money, to determine more diligently about singulars ; nevertheless, it is irrelevant to dwell further on such matters while aiming to consider higher things.⁴

1. *Loc. cit.* Also in the commentary on ARISTOTLE'S *De Sensu et Sensato*, I, lect.1.

2. *In I Politicor.*, lect.6.

3. *Ibid.*, lect.9.

4. *Ibid.* See also BABIN, Eugène, *Aristote, La Politique*, nouvelle traduction et notes, Livre I, M. Doyon, Québec, 1956, pp.95-96. The universal nature of these arts is the proper concern of the philosopher, who should consider even the operable in its universal or changeless nature, but not as operable — for this is to reach out to the singular, which

Those who wish to have a detailed and practical knowledge of these arts are then referred to the writings of those philosophers who have treated them more thoroughly :

Therefore, he says first, that, since certain philosophers have written on the foregoing matters — such as Chares, the Parian, and Appolodorus, the Lemnian, who wrote about the cultivation of the land, whether bare or planted, or as among the Latins, Palladius, and others who have written on the other practical arts — whoever wishes to know more fully about them should consult their books.

In this study, we will be guided by the manner in which St. Thomas treats of these arts. First, we will consider agriculture as a practical art, subordinated to politics. Under this aspect, we will consider it primarily in its universal nature, and then, briefly, in reference to its use. In regard to its universal nature we will consider first the genus of art to which it belongs, namely, the cooperative arts. Then we will consider it in its species : as an art by which food, and other goods are provided for the human community, both domestic and civil. Finally, we will consider it in reference to its first principles, which is to consider it as subordinated to the philosophy of nature in general, and to the more particular ramifications of this philosophy — the so-called natural or experimental sciences.

If the teachings of St. Thomas on agriculture are sound, we can expect to find that what he has to say in a generic way will be reiterated more particularly in special works on the subject. We will make use of the opinions of some of these agriculturists along with those of St. Thomas, inasmuch as they will serve to bring his teachings down to a more concrete level, and to corroborate their soundness.

There is a timely reason for dwelling on the subject of agriculture in a philosophical way. By tracing the art to its speculative foundations, as we will be doing if we can determine something about its universal nature and its first principles, some light may be thrown on a disputed question as to the proper method to be followed in the practice of agriculture ; and, even more so, on the nature and scope of agricultural research. The question might be put in this form : Has the new scientific knowledge at man's disposal given him the power to make his own terms, conditions and quotas in the production of his food, or must he still consider his knowledge and his practices as being subordinated and ministerial to the natural forces which are at work ? Those who take the affirmative of the first part of this dispute in their practice and theory do not so much argue the question as assume the answer. Contemporary practices point increasingly to the implicit, if not explicit, acceptance of this view. Natural

acquires more particular and appropriate knowledge of things in their concretion, and to consider them in this fashion is not speculative.

fertilizers are indiscriminately replaced by chemicals ; when any disease or pest threatens the crops or animals of the farmer, science supplies a preventive, or a remedy, in the form of a poison, or a hormone or some other such thing, so that no crop or animal is required to have the hardiness to weather the threat ; when a strain of plant or animal loses its hardiness or productiveness, strains of plants and animals are developed which produce, under forced conditions, unbelievable amounts of grain, fruit, eggs, meat, wool, etc. These are just a few of the ways in which science is altering the old practices.

Those who are opposed to the assumptions which underlie these practices are more articulate. Howard, for instance, has this to say :

On this ingenuity and on these inventions rests, so it is claimed, the constantly growing food supply needed by modern populations, and much time is devoted to reckoning up the magnitude of this human achievement. The argument is based on figures of increased crop and animal production over the last few generations of human life and ignores the fact that these results depend on the plunder of the capital of the soil. The conclusions reached are fundamentally erroneous and are fraught with the certainty of failure and catastrophe.¹

Fairfield Osborn gives a similar warning :

[Man] causes the life giving soils for his crops to wash into the oceans. He falls back on palliatives and calls upon a host of chemists to invent substitutes for the organized processes of nature. Can they do this? Can his chemists dismiss nature and take over the operation of the earth? He hopes so. Hope turns to conviction — they must or else he perishes. Is he not nature's crowning glory? Can he not turn away from his creator? Who has a better right? He has seemingly "discovered" the secrets of the universe. What need he, then, to live by its principles?²

I. THE CONCEPT OF COOPERATIVE ART IN ST. THOMAS

Agriculture is one of a group of arts which can, appropriately, be called cooperative arts. For a first understanding of St. Thomas' conception of agriculture, then, it will be helpful to examine what he says about arts of this kind, since a consideration of the genus is prerequisite. And this understanding will in turn be easier if certain things are presupposed which are true of art in general.

All art has as its purpose the production of something which nature either cannot make, or which it does not make so conveniently ; and, moreover, art accomplishes this end by means of the operation

1. *The Soil and Health*, p.195.

2. *Our Plundered Planet*, p.31.

of natural principles.¹ Art, therefore, presupposes nature, because it produces its work by making use of natural things and of their operations. These are, in a manner of speaking, the matter of art.² The form of art is, in a general way, an imitation of nature. All art, St. Thomas says, imitates nature as far as it is able to. He gives the reason for this proposition in both the *Physics* and the *Politics*. In the *Physics*, he says :

The reason for the statement 'art imitates nature' is this : the principle of artificial operation is knowledge ; but all of our knowledge is drawn from sensible and natural things through the senses ; thus we produce a likeness of natural things in artificial things. Therefore natural things are imitable through art, inasmuch as all nature is ordered to its end by some intellectual principle, so that the work of nature seems to be a work of intelligence to the extent that it proceeds towards definite ends by determinate means ; which art also imitates in its operation.³

The passage in his commentary on the *Politics* is more explicit :

As the Philosopher teaches, in book II of the *Physics*, art imitates nature. The reason is as follows : as principles are to each other, so, proportionally, are the operations and effects which proceed from them. Now the principle of those things which are made by art is the human intellect, which by way of a certain resemblance is derived from the divine intellect which is, in turn, the principle of natural things. Whence it is necessary that both the operations of art imitate the operations of nature, and the things which are from art imitate those which are from nature. So that if any instructor of an art should bring about a product of that art, it is fitting that the disciple, who is learning the art from him, should pay attention to that work, and from this similitude learn to operate himself. And thus the human intellect, which has the light of intelligence by derivation from the divine intellect, when it makes something, must of necessity be informed by an inspection of those things which are made naturally, and operate similarly in its work. And thus it is that the Philosopher says that if art were to make those things which are made by nature, it would operate similarly to nature : and, conversely, if nature were to make those things which are by art, it would make them similarly to the way art does. But nature does not make those things which are by art ; but rather, it only prepares certain principles, and, in some manner, offers an exemplar for operating by art. Art, however, can examine those things which are by nature, and use them for performing its proper work ; but it cannot make them itself.⁴

1. *De Potentia*, q.4, a.3, c. Also, *In IV Sent.*, d.42, q.2, a.1, c. The purpose of art is to supply the things that nature fails to supply, either absolutely speaking, or in some respect.

2. *Q. D. de Veritate*, q.11, a.1, c. ; *In II Physicor.*, lect.4 and 13.

3. *In II Physicor.*, lect.4.

4. *Ibid.* I, Prooemium. — Perhaps we should point out that 'to be like nature' and 'to be of nature' are not the same thing.

The reason why art cannot make the things in the way nature does is that the power of art does not extend directly to the substance of things, but only to the accidents. The substance of things is made by generation, from a principle that is first and intrinsic to its cause ; whereas art is a principle that is extrinsic to nature. For art is in the reason, and reason differs from nature inasmuch as it is above contraries. For the notion of blindness does not destroy the notion of sight. The latter is essential to the former. But one cannot in fact both see and be blind, except successively. In this sense reason and art are extrinsic to nature. But they can act upon nature by way of direction and command. The forms produced by art itself are those of composition, order and figure.¹ However, nothing prevents art from bringing about the substance of a thing by making use of what is already provided by nature, either proximately, such as wheat to make bread, or remotely, such as hydrogen to make new types of atoms. In such cases art makes things by applying natural forces to produce effects, some of which could be wrought by nature alone, others only with the help of our own reason.²

The cooperative arts.

Thus, although nature does not produce the things which are proper to art, nor art, those which are proper to nature, there are certain things which can be brought about both by nature and by art. Examples of these are health, or knowledge, or food. Knowledge can come directly from things, or it can be acquired through instruction or teaching. Health may come about through the natural restorative powers of the living body, or thanks to the art of medicine. And food may be produced by nature alone, or by the arts of agriculture and husbandry.

First of all, it is fitting that there should be arts of this kind, for the ends intended by nature's operations do not always materialize. In some cases nature operates by necessity, in other it operates regularly, but not unfailingly. For instance nature intends that living beings should have health, but some fail to achieve it, due to some interference with the working of organs. Moreover, even where nature does not fail to realize its intentions, the effects may be lacking from some point of view. Thus, nature intends that there should be food for living bodies, and, in general, it does not fail to supply it ; but it is

1. *Summa Theologica*, IIa IIae, q.96, a.2. Also ARISTOTLE'S *Physics*, Book II, ch.1. Nature is there defined as "a principle and cause of motion and of rest in those things in which it is primarily, *per se*, and not accidentally." Also *Q.D. de Potentia*, q.6, a.1, ad 18. And *In II Sent.*, d.I, q.1, a.4, ad 3 : "Specifically the same effect cannot come from diverse immediate agents, having operations determined to their effects, as from art and nature."

2. Cf. *Summa Theologica*, IIIa, q.66, a.4, c.

not the business of nature alone to supply food for man in conditions of his own designing, which he is due to create if he is to lead a civilized life. Under these conditions, art is required to supplement the work of nature. An appropriate name for these arts is 'cooperative arts.' St. Thomas also calls them ministerial arts. These are described in many of his works. In the *Summa Theologica* he says :

... Of effects proceeding from an extrinsic principle some proceed from that principle alone, as the form of a house is produced in the materials by art alone. But other effects proceed now from an extrinsic principle, now from an intrinsic principle ; and thus health is caused in a sick man sometimes by the former [such as medical art], sometimes by an intrinsic principle [as when a man is healed by the power of nature alone].

In these latter effects two things must be noted. First, that art in its work imitates nature, for just as nature heals a man by alteration, digestion and rejection of the matter that caused the sickness, so does art. Secondly, we must remark that the extrinsic principle, art, acts not as the principal agent, but as helping the principal agent, which is the interior principle, by strengthening it, and by furnishing it with instruments and assistance, of which the intrinsic principle makes use in producing the effects.¹

It is to be noticed, again, that the things produced by the work of these arts are not artifacts in the strict sense of this term, but things of nature. They can be called artifacts, however, in reference to their mode of production.

In the *De Veritate*, St. Thomas speaks still more clearly of these arts :

We must bear in mind, nevertheless, that in natural things something can preexist in potency in two ways. In one, it is in an active and completed potency, as when an intrinsic principle has sufficient power to flow into perfect act. Healing is an obvious example to this, for the sick person is restored to health by the natural power within him. The other appears in a passive potency, as happens when the internal principle does not have sufficient power to bring it into act.

Therefore when something preexists in active and completed potency, the external agent acts by helping the internal agent and providing it with the means by which it can enter into act. Thus in healing the doctor assists nature, which is the principal agent, by strengthening nature and prescribing medicines which nature uses as instruments for healing . . .

In effects which are produced by nature and art, art operates in the same way and by the same means as nature. For as nature heals one who is suffering from a cold by warming him, so also does the doctor. Hence art is said to imitate nature.²

1. *Ia*, q.117, a.1, c. Other passages are found in the commentary on the *Metaphysics*, VII, lect.6 ; the commentary on the *Physics*, II, lect.13 ; *The Summa Contra Gentiles*, II, c.75 ; and *De Potentia*, q.6, a.3.

2. *Q.2*, a.1, c.

The words of St. Thomas, that these arts operate in the same way, and by the same means as nature does, deserve further study ; for, as mentioned above,¹ this is a principle which in contemporary agricultural practice is honored more in the breach than in the observance.

The first and most important things to be remembered about the cooperative arts is that they cooperate with nature as a secondary and helping agent, and not as a primary or equal one. The reason is that the things produced by such arts are things of nature and primarily the result of natural causes. The purpose of such art is to help nature — their operations presuppose those of nature, and art is unable to duplicate these by its own power alone ; for, as was said above, the power of art does not extend directly to the substance of things, but rather to such things as figure, composition and order. This presupposes an aptitude in the natural substance for such accidents, which is realized primarily by the active power of the natural agency, though with help of the art.

There are four ways in which one agent can cooperate with another : by counsel, help, disposition, or by means of a tool.² In reference to nature — the principal agent — a cooperative art like agriculture cooperates by helping and by disposing. As St. Thomas says in the *De Potentia* : " In some cases art perfects that which nature cannot make ; in some, however, it produces an order in nature, as the doctor does to heal, by altering and directing, through the apposition of those things which have a natural virtue to do this."³ But in reference to politics and economics, to which agriculture, and the other useful arts are subordinated by reason of their end, these arts cooperate as instruments of the former, or by deliberation, which is made plain by St. Thomas in his commentary on the *Politics*.⁴

In the second place, it should be remembered that inasmuch as these arts imitate nature, the imitation consists of operating in the same way and by the same means as nature does — or would, if she could. The reason for this imitation is the fact that the exemplar which governs the operations of reason in art must be taken from nature ; for that which these arts aim at is something which nature can produce by natural powers. In the commentary on the *Metaphysics*, St. Thomas gives an example of this characteristic :

It is plain, therefore, that just as in natural things a man is generated from man, so also in artificial things it happens that in some manner health comes to be from health, and a house from a house ; namely, when that which has matter comes from that which exists without matter in the mind.

1. Pp.197-198.

2. In *IV Sent.*, d.5, q.I, a.2, c.

3. Q.6, a.3, c.

4. In *I Politicor.*, lect.8 and 9.

For the art of medicine, which is a principle of healing, is nothing but the conception of health which is in the mind.

And just as the doctor, who wishes to bring about health, begins by considering what health is, such as that it is a certain balance, then he should know what this is, such as a suitable proportion of humors in reference to human nature. But this may occur if the body is made warm, if the infirmity in question is due to a lack of warmth. And, again, he should know what this is, namely, to be warmed ; as if he were to say that to become warmed is to be immuted by a heated medicine. But to give a heated medicine is something within the immediate power of a doctor to do, and it is now within his power to provide this remedy.¹

Now, when one thing imitates another, it does so by a specific likeness of its exemplar. A true imitation, or image is more than a generic likeness. It is a likeness in kind ; that is, either the same in species or in some sign of the species, such as a quality, like shape or disposition. Not only is this kind of likeness required for an image, but it must also refer to an original. The image is seen as proceeding from the exemplar. An egg is not said to be the image of another, for it is not seen as originating from it — to use St. Augustine's example. But the drawing of an egg is an image ; and so is a statue, even though it is not the same in species as the person it represents, but it has a specific resemblance in shape, which is a proximate sign of the species. There must, therefore, be this type of equality between exemplar and image, but it need not be an absolute equality, but only a proportional one. Nor does a statue have to be the same size as its exemplar, but it must be proportionally the same in size.² To say, then, that a cooperative art imitates nature is to say that it uses proportionally the same ways and means as nature does. Its operations and the means that it uses must be specifically proportional to those of nature.

Agriculture as a cooperative art

In the commentary on the *Politics*, St. Thomas speaks of agriculture as an art by which food is acquired for use in the home and the civil community. But it is the proper task of nature to produce food, and its operations are presupposed in the work of agriculture. To explain this, St. Thomas reasons as follows : It is the office of nature to provide whatever is needed by the things that are produced by nature. But men, and other living things, are generated by nature ; and they require food to sustain their lives. Nature, however, does not fail in necessary matters, and thus it provides food for living things. We see that nature provides food for animals in the

1. *In VII Metaph.*, lect.6.

2. *Summa Theologica*, Ia, q.35, a.1, c., and q.93, a.1, c. ; also *In I Sent.*, d.28, q.2, a.1, c.

beginning of their lives. The embryo which is in the egg makes use of the rest of the egg's substance as its food ; and nature provides food for young mammals in the mother's milk. And as animals continue to grow and complete their lives, nature continues to provide food for them. Thus plants serve as food for some animals, while others live on animals. Man in turn uses all, or most, of the plants and the other animals as his food, or to satisfy other needs ; for the needs of man are manifold, and all of the other things of nature are at his disposal, for this is their end.¹

Though it is the business of nature to supply food for man, it does not follow that nature, alone, has the completed power to supply food in the abundance, the regularity, the variety and the places which are required for life in the political community, which is the proper mode of human life. By nature man is destined to live in a civil community ; yet this community and its conditions are not the work of nature, but of reason and art. Man differs from the other animals in this respect, for they are directed by instinct in their actions, whereas man should be directed by reason and art.² To illustrate this fact, St. Thomas points out that while the other animals are naturally endowed with all the equipment and instruments for carrying on their lives, such as natural clothing, means of attack and defence, etc., man is not naturally endowed in this way. In place of these he has reason and hands which are a kind of universal tool, a tool of tools inasmuch as reason and hand may produce an infinite variety of tools. The universality of the uses of man's hands makes them the proper counterpart for the universality of his reason. And, since man's needs spring, not from nature alone, as do those of other animals, but from reason, which is universal, so also the means of satisfying these needs arise, not from nature alone, but from reason and art which is nothing else but right reason about making things.³

Therefore, for the acquisition of food man stands in need of art, the purpose of which is to supply food in the abundance, the regularity and the variety needed for life in the civil community. And, among the food productive arts, only agriculture is equal to this task. Living beings are generated, nourished and brought to maturity by means of the vegetative powers of the soul, and these are active and completed potencies — according to the distinction quoted above known to us by their observed effects. — They are principles of fertility in nature. By means of them food is supplied to living beings.

The primitive arts by which man acquires his food, such as hunting, fishing and shepherding, are arts of interception. In them,

1. *In I Politicor.*, lect.6 and 8. Also in the commentary on ARISTOTLE's *De Anima*, II, lect.7.

2. ST. THOMAS, *In I Post. An.*, lect.1.

3. ST. THOMAS, *In III Physicor.*, lect.5.

man takes directly from nature the food naturally produced. To live by these arts man must live within the limits of nature itself. But by agriculture man directs, helps and enhances the forces of fertility ; he releases new and untapped energies and, in general, he intervenes in the operations of nature to bring about their utmost fulfillment, which is a condition of advanced political life. " The sun and stars cooperate in the work of production by their movements as the husbandman does by his labour."¹ Thus agriculture is a cooperative art in the strictest sense of this term.

The words " culture " and " cultivate " are used most appropriately of farming ; for its work is the cultivation of the soil, and of the things that grow in the soil, and of the animals that are nourished by these. Each of the principal parts of agriculture, namely, tillage, cultivation and husbandry, is a cultivation, by means of which the natural forces of fertility are brought to the service of reason, which is their end. The same may even be said of fertilizing, which in a certain sense is the fourth part of agriculture.

Tillage is the primary operation of agriculture. Albert Howard, the British agriculturist, describes the effects of tillage as follows :

The first effect is, of course, physical. The loosened soil makes room for the seed, which can thus grow in abundance, while to cover the sowing with scattered earth or to press it into the ground protects it from the ravages of birds or insects. Secondly, tillage gives access to the air — and the process of soil respiration starts up, followed by the nitrification of organic matter and the production of soluble nitrates [immediate plant food]. The rain too, can penetrate better. In this way physical, biological and chemical effects are set in motion and a series of lively physiological changes and transformations result from the partnership between soil and plant. The soil produces food materials : the plants begin to grow : the harvest is assured : the sowing has become a crop.²

Of the operations which follow tillage, one is concerned with the care of growing plants and animals. It is the farmer's business to see to it that the growing things obtain the nourishment, and whatever is required for maturing ; and to forestall the agencies which threaten their development. The other operation is that of fertilizing, one made necessary by the practices of tillage, cultivation and harvesting ; it is the counterpart of these. The effect of tillage and harvesting is a great depletion of soil fertility. Fertilizing aims to restore and maintain fertility.

In all these operations agriculture is, to use the words of St. Thomas, helping and directing and strengthening the work of natural forces, by applying these to their proper effects. It is a cooperative art throughout.

1. *Summa Theologica*, Ia, q.70, a.1, ad 4.

2. *The Soil and Health*, p.34.

St. Thomas' statement — that a cooperative art operates in the same way and by the same means as nature does — must not be interpreted as meaning that the art does not have its own operations, to distinguish it from the work of nature. "In every practical art", he says, "there is an end proper to it and means that belong properly to that art."¹ The same specific effect cannot, he says, be produced by diverse immediate agents which have determinate operations to their effects, such as nature and art.² Only when one is subordinated to the other in their operations, as ministering to it, can the two produce the same effect; and this is the case in the cooperative arts.

When it is said that a cooperative art operates by the same means as nature does, we must observe that the manner in which this is accomplished by art is not the same as that of nature, for the effect is then proper to the art. Again, the art has as its end to bring about a natural product, yet its own end is not the product as it is produced by nature, but as it is produced by art.³

The means which are proper to agriculture have been stated above. The principal means are tillage, cultivation, husbandry and fertilizing. In each of these operations art is doing something which nature does not do. As Howard says:

Yet this is not the way in which Nature is accustomed to work. She does not, as a rule, collect her plants, the same plants, in one spot and practice monoculture, but scatters them: Her mechanisms for scattering seed are marvelous and most effective. Man's habit, so convenient, of collecting a specified seed, and sowing it in a specified area implies, it must be acknowledged, a definite interference with Nature's habits. Moreover, by consuming the harvest and thus removing it from the place where it had grown, he for the time being interrupts the round of natural processes.⁴

It is the same with cultivation and animal husbandry. Nature does not stir up the soil and remove weeds, prune branches and practice the other activities of cultivation; nor does she separate her animals and raise them under the artificial conditions that husbandry makes use of. Finally, the proper end of agriculture is the crop. The crop is an effect of art, not of nature. In comparison with the crops and animal products produced by agriculture, nature's harvests

1. *Summa Theologica*, Ia IIae, q.8, a.2, ad 3.

2. *In II Sententiarum*, d.I, q.1, a.4, ad 3.

3. *Commentary on the De Sensu et Sensato*, Book I, lesson 1. "From which it appears that the consideration of health and sickness is common to both the doctor and the natural philosopher. And the reason for this is that health is sometimes caused by nature alone, and this pertains to the consideration of the natural philosopher, who considers the works of nature; and sometimes it is caused by art, and in this respect it is considered by the medical man."

4. *The Soil and Health*, p.34-35.

are "dispersed, scanty and irregular." Crops, as Howard says, are the result of the special operations of agriculture. They are meant for removal and consumption in the domestic and the civil community.

The result of these special practices, as Howard points out, is a disturbance and an interruption of the processes of nature. "In fact man has laid his hand on the great Wheel and for a moment has stopped or deflected its turning. To put it in another way, he has for his own use withdrawn from the soil the products of its fertility. . . . But if he is to continue to exist, he must send the wheel forward again on its revolutions. . . . all the great agricultural systems which have survived have made it their business never to deplete the earth of its fertility without at the same time beginning the process of restoration."¹ This is the reason for the other practice which is proper to agriculture, namely, fertilizing. And in this process also, the practices of agriculture differ from those of nature, and exceed it ; for the operations of fertilizing must be proportional to the crops produced, and to the depletion thus entailed.

Despite the difference between the means which are proper to nature and those proper to agriculture, the operations of agriculture must imitate and be patterned on those of nature. This is so because the proper effects of agriculture are not achieved by the means proper to agriculture as their principal cause, but rather by natural forces as aided and directed by the proper methods of agriculture. And, because the operations of agriculture minister to the natural forces at work, they must be proportioned to them. The operations of nature, as St. Thomas points out in the commentary on the *Physics*, seem to be the work of intelligence, and it is from nature that man draws his knowledge, through the senses ; which knowledge is the principle of his art.² We have seen, in the lines of Columella cited above, that among the ancients also the idea that God and nature is the first farmer, was a guide to their thought on agriculture. Howard insists throughout his books, that nature is the supreme farmer, and her practices the first principles of everything which the art of farming undertakes. The same is true with other writers whom we quoted. Paul Sears has this to say :

Nature is not to be conquered save on her own terms. She is not conciliated by cleverness or industry in devising means to defeat one of her laws through the workings of another. She is a very business-like old lady, who plays no favorites. Man is welcome to outnumber and dominate the other forms of life, provided he can maintain order among the relentless forces whose balanced operation he has disturbed.³

1. *The Soil and Health*, pp.34-35.

2. *In II Physicor.*, lect.4.

3. *Deserts on the March*, p.5.

The current literature on agriculture, says Howard, pays scarce attention to the means which nature, the supreme farmer, uses in her management of the soil. Nevertheless these natural methods must form the basis of all our studies of soil fertility.¹ Nature's methods are best seen in the life in woods and forests. He then summarizes the lessons to be learned as follows :

Mixed farming is the rule. Many species of plants and animals live together . . . there is never any attempt at monoculture. . . .

The soil is always protected from the direct action of sun, rain and wind. In this care of the soil strict economy is the watchword : nothing is lost. The whole energy of sunlight is made use of by the foliage of the forest canopy and of the undergrowth. The leaves also break up the rainfall into fine spray so that it can more easily be dealt with by the litter of plant and animal remains which provide the last line of defense of the precious soil. These methods of protection . . . also reduce the power of the strongest winds to a gentle air current.

The rainfall in particular is carefully conserved. A large portion is retained on the surface of the soil : the excess is gently transferred to the subsoil, and in due course to the streams and rivers. The fine spray created by the foliage is transformed by the protective ground litter into thin films of water which move slowly downwards, first into the humus layer and then into the soil and subsoil. These latter have been made porous in two ways ; by the creation of a well marked crumb structure and by a network of drainage and aeration channels made by earthworms and other burrowing animals. The pore space of the forest soil is at its maximum so that there is a large internal surface over which the thin films of water can creep. There is also ample humus for the direct absorption of water. There is remarkably little run-off even from the primeval rain forest. When this occurs it is practically clear water. Nothing in the nature of erosion occurs. The streams and rivers of the forest areas are always perennial because of the vast quantity of water in slow transit between the rainstorms and the sea. There is therefore little or no drought in forest areas because so much of the rainfall is retained exactly where it is needed.

The forest manures itself. It makes its own humus and supplies itself with minerals. If we watch a piece of woodland we find that a gentle accumulation of mixed vegetable and animal residues is constantly taking place on the ground and that these wastes are being converted by fungi and bacteria into humus. They are sanitary. There is no nuisance of any kind. . . .

The mineral matter needed by the trees and the undergrowth is obtained from the subsoil. This is collected in dilute solution in water by the deeper roots of the trees . . . Even in soils markedly deficient in phosphorus trees have no difficulty in obtaining ample supplies of this element. . . . Nature's farming, as seen in the forest, is characterized by two things : (1) a constant circulation of the mineral matter absorbed by the trees ; (2) a constant addition of new mineral matter from the vast reserves held by the subsoil. . . .

1. *An Agricultural Testament*, pp.1-5.

The soil always carries a large fertility reserve. . . . The extent of this enormous reserve is only realized when the trees are cut down and the virgin land used for agriculture. When plants like tea, coffee, rubber, and bananas are grown on recently cleared land, good crops can be raised without manure for ten years or more.

The crops and livestock look after themselves. . . . It is true that all kinds of diseases are to be found here and there among the plants and animals of the forest, but these never assume large proportions. . . .¹

The principles which govern the processes of soil and life in the prairies, the rivers and the sea are similar to these. In all cases the result of nature's farming is a building up of fertility, and a gradual conquest of bare land by vegetation. The island of Krakatao is a good example of this law. In 1883 a volcano reduced the island to bare rock and sand. Twenty years later it was again covered with vegetation.²

The soundness of any system of agriculture must be judged, primarily, by the extent to which it adheres to the principles which are furnished it in the exemplar of nature's farming. According to Howard, the agriculture of the Orient has grasped these principles and adhered to them faithfully. This agriculture, he says, has passed the supreme test ; the test of time. The small holdings of China, for example, are still maintaining a steady, and a high output with no loss of fertility after as much as forty centuries of management.³ To a lesser extent many other peoples have learned to follow nature's laws in their farming. In the works we have referred to, Howard gives many examples of this, taken from his own observations. He describes the Chinese method of making humus by composting all vegetable and animal wastes, as a careful imitation of the manner in which it is made in the forest. It is like rolling up the forest floor and arranging it in a heap, he says. Another example is the way in which the peasants of Northern India ward off the threat of the formation of a hard soil pan under their fields — a condition which leads to the development of alkali salts in the soil and the end of its fertility. They plant deep rooting legumes between other crops, and the roots of these legumes break up the subsoil, thus maintaining its permeability and fertility. In another place he tells how he induced the hop growers in a part of England to add the male hops to their plantings, alongside the commercially valuable female plants. The female plants were then pollinated, as nature intended they should be, and they acquired the hardiness to throw off the disease which threatened to destroy them.⁴

1. *An Agricultural Testament*, pp.1-5.

2. MANGHAM, Sidney, *The Earth's Green Mantle*, New York, Macmillan, 1939, p.25.

3. *An Agricultural Testament*, pp.9-17.

4. *The Soil and Health*, p.2.

Many examples of the ways in which agriculture imitates nature are found in the farming practices of our own country, as well. At present, many cattle are brought from the western plains to the cornfields of the midwest, to be fattened on the corn, before being taken to the stockyards. Formerly they were fattened at the stockyards, the grain being shipped in from the farms. Aside from the economy of this practice it is also closer to the conditions of nature where plant and animal life are never isolated from each other. Thus the farmers receive the benefit of the manure on their fields, which helps to maintain the humus reserve — a condition required by nature. Again there is the practice of orchardists, who chop up the grass cover in their orchards with harrows ; or, in some cases, of piling straw around the base of the trees. In both instances they are imitating the conditions of tree life in the woods, where grass does not grow. The grass cover prevents the air from penetrating to the tree roots, and thus interferes with their proper growth. Many market gardeners spread a mulch of vegetable wastes around their crops, as a means of protecting the texture of the soil surface and of conserving moisture. In doing so they are seeking the same effects that are brought about by the litter on the forest floor.

If these opinions about the nature of agriculture are sound, then certain questions which are now being asked about its operations are already answered. The point is expressed concisely in the words of Fairfield Osborn, cited above : " Can his chemists dismiss nature and take over the operation of the earth ? " ¹ Taken literally, the affirmative would be circular ; for the chemists can only take over the operation of the earth by applying certain natural powers to their proper effects. But this is not the author's meaning, as the rest of his book makes clear. What it does mean is this : can modern science make use of the new knowledge to set its own terms, or those of society, in the management of the soil and of the plant and animal life which it nourishes, without essential obedience to the principles which nature sets forth in its own management of the soil, and its own creatures ? When it does, the results are a disturbance of the balance in nature, and the inevitable loss of fertility. For man is then trying to defeat the operation of some natural laws through the working of others, as Paul Sears warns.²

This leads, quite naturally, to a second question : can man exceed nature through the practice of agriculture ? The answer to this question is, of course, that he can. If this were not so then agriculture would lose all or most of its reason for existing. But the condition for such an achievement is that his operations must be proportional to those of nature. They must be characterized by

1. *Our Plundered Planet*, p.31.

2. *Deserts on the March*, p.5.

balance. We find this view reiterated throughout the writings of these men. Howard summarizes his views on this point in the following words :

My constant references to nature as the supreme farmer have been found inapplicable and inept, it being pointed out that if we were to follow nature alone we would be restricted to those small harvests that she alone is accustomed to provide.

... I am accused of ignoring the fact that the whole aim of the cultivator is to do better than nature and that the success attained in this direction is a source of legitimate pride.

... The conception of agriculture as an interruption or interception of natural processes has always been recognized by me. Where I part company with my critics is in my general view of the unbalanced nature of these human acts... These interruptions or intrusions must not be confined to mere exploitation : they involve definite duties to the land which are best summed up in the law of return. They must also realize the significance of the stupendous reserves on which the natural machine works and which must be faithfully maintained.

The first duty of the agriculturist is to understand that he is part of nature and cannot escape from his environment. He must obey nature's rules. Whatever intrusions he makes must be, so to speak, in the spirit of these rules. They must on no account flout the underlying principles of the natural laws nor be in outrageous contradiction to the processes of nature. ...

But provided that the actions of the cultivator are well conceived, that they have been proved successful by long experience, and that the character of the intervention undertaken is comprehended, and that measures are initiated to restore the natural cycle in a proper way, much may be accomplished by man : and this is the art of agriculture.¹

It is necessary that agriculture exceed nature and that it should do so greatly. This is immediately deducible from what we have reported on the nature of the art. From the viewpoint of the final cause, because the purpose of the art is to bring about what nature cannot accomplish ; from that of the agent cause, because art is a relatively superior cause to nature, for it proceeds directly from intellect. And the truth of this is seen even more readily on the part of the effects. The crops of agriculture are superior to the harvests of nature, not only in that more is produced, but also, and even more so, in quality. No one can be unaware that cultivated plants and animals are better in size, taste, texture and almost every other quality that food can have. And, finally, agriculture accomplishes its results much more efficiently and rapidly than nature does. In his book, *Pleasant Valley*, Louis Bromfield describes how he built up five inches of fertile soil on a badly eroded field in as many years. It would take

1. *The Soil and Health*, pp.194-196.

nature hundreds of years to accomplish the same effect. Howard describes how the Chinese get several crops from the same field in one year, by planting new crops before the older ones are harvested. Vegetables and fruits started under glass mature earlier, and can often be produced in unfavorable climates where natural conditions would exclude them. These examples are enough to suggest the innumerable ways in which agriculture exceeds nature.

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(To be continued.)
