PLANTS AND MANKIND

Inaugural Lecture delivered at the

University of Strathclyde

7th February 1966

by Professor B. Binns, M. Sc., Ph. D., F.L.S

On this earth today there are well over half a million species of flowering plants, but there is only one species of man. Plants have been on this earth for some 4,000 million years, but man hardly a million. During this long time, three major events have happened to plants: they came out of their first home in the sea, they learned how to produce seeds, and they encountered man. Of these three, the event that seems to have changed them most, has been the arrival of man.

Ii therefore, we look at these three events, and especially the last of these, we may find out what man has done to, and for, plants, and indeed what plants have done to, and for, man. To understand this fully we should look also at those other happenings before the arrival of man; the first of these was the march of the plants, out of the early seas where they had originated, forward to the landward areas. As they climbed from the rocky foreshore they evolved bigger and better types; the algae gave way to the lichens, the liverworts and mosses followed, then the ferns and the pines, and finally the plants with showy flowers and seeds borne inside larger fruits. The simpler forms continued to live on in their easier habitats, while the more advanced and therefore the more efficient, gained a foothold in the difficult places of the earth. They even contrived to live with that dominant type of earth-changing creature, man himself.

The second great event in the long history of plants was their acquisition of the seed-forming habit. When plants, and animals too, left the seas, they met with the same difficulty, the proper care of their eggs. The egg, before and after fertilisation, requires a moist environment, and both animals and plants met this difficulty in the same way; they retained their eggs inside the maternal tissues until they became embryos. Then came a difference. The animal mammals produced their young alive, and fed them after birth with mothers' milk. The plants, however, retained their embryos in a dormant and dehydrated environment internally, often supplied them also with a reserve of food material, surrounded them with a waterproof skin, and shed them in that state. They could then rest in or on the soil until they would meet with water and the other right conditions for germination and growth.

These were the seeds. Such seeds became more efficient as the long geological eras passed, until finally it was no longer necessary to produce enormous seeds like those of the Cycas and the Coconut; minute seeds like those of the Orchid were to become even more effective. Now the assumption of the seed habit enabled plants to migrate .from the easier tropics to the colder zones and to the drier zones of the earth, because the resting seed could stay dormant in unfavourable conditions; they could rest for a few days, a few years, or even a century or so like the Chinese Water Lily, *Nelumbo*. They could compete with other germinating seeds for soil, light and air, and finally settle down, as all living organisms have to do, into balanced communities of vegetation that we can recognise today -the tropical forests, the tropical bush land and grassland, the temperate forests and grasslands, as well as the deserts of the colder and the hotter regions of the earth.

In the long course of such evolution, many experimental oddities arose, some of which have survived to this day. There have been nutritional oddities such as the insect-trapping plants which, lacking an adequate physiological mechanism for the absorption of nitrate as a source of nitrogen in the boggy lands where they live, have taken to obtaining their nitrogen as protein-nitrogen from the bodies of insects. There have been mechanic8:foddities such as some of the fungi which, having no woody tissue as such, yet are strong enough to grow under, and break up, a tar macadam roadway. There are physiological oddities such as the sleep-habits of plants, their leaf-folding and their hours

of flower-opening, all of which exhibit a sensitivity to the spectrum of light. Again, especially among the tropical plants, there is a strange multiplicity of devices to ensure the effective distribution for their seeds and fruits by adherence to passing animals, by wind transport or by fleshly attractions to birds.

Plants, without a brain, without a mind and without an intelligence as we understand it, have fashioned mechanically efficient structures before man even tenanted the earth.

When man finally evolved, he came from a group of primates whose ancestors lived m trees, for the trees gave them all they needed. For a home, they squatted in the fork of a tree secure from the carnivorous animals; for shelter, they pulled a leafy branch over their heads. For food, they ate the leaves from the branches, and when there were none, they chewed the bark; with luck, they might also have juicy flowers and sweet fruits. But as long as man lived on leaves, on bark, and on fruits, he had to be always eating. This was the pattern of living for our primate ancestors, until the grasslands .developed where there was not enough water to support forest growth. They developed In the open spaces of the forest, along the river plains, and In the vast areas in the drying continents beyond the forest zones.

Now the grasses had this characteristic of use to man - the production in vast quantities of closely-growing seed grains, which have a store of concentrated dehydrated starchy food around their embryos. Here at last was a change indeed in diet. This can be thought of in terms of energy intake and output. The food a man eats is his source of energy; when it is burned up, or better, respired, it releases the energy he needs for work, for pleasure, for eating, for sleeping. His requirements depend on what he does. A student needs some 3,000 calories per day if we can suppose that he spends 12 hours of his day in sitting down studying, and 8 hours sleeping. Someone doing heavy work would need some 5,000 calories.

Our early man living on leaves would require an enormous quantity of them; to 'get 3,000 calories for a day, say at two-fifths of a calorie per gram of fresh leaves, he would need 37 lbs. in that one day. When however he came down from 1he trees and foraged in the grasslands, he would need only some 24 oz, say 600 grams at 5 calories per gram. We may well enquire what differences this might make to his way of life.

In the first place, he could leave home on little voyages of exploration for longer periods. In his leaf-eating stage, to be sure of his food supplies for even a day and a night, he would have to carry 37 lbs. of leaves with him, and a bundle, or two, or three of leaves would not only be fairly heavy, but would not last many hours; they would soon wilt, and even begin to decay. With the advent of the grain-eating habit however he could go away with 24 oz. of grain in a small pouch, and be thus equipped with food for a day and a night.

Paradoxically, man's need to roam created man's need for a home -a place to come back to, a place for his wife and his children, and it all began with the seeds of the big-grained grasses. This leads us to a sweeping conclusion that if plants had not developed seeds, man could not have developed a civilisation. The first civilisations did in fact arise around the centres of origin of the large-grained grasses-rice in S.E. Asia, maize in Central America, wheat in Abyssinia and the Middle East countries, and the millets in Africa. We can notice that there were no big civilisations around the centres of origin of other important sugary or starchy foods, neither the yam nor the banana-plantain, neither the sugar-cane nor even the potato, though they all eventually came to be very important, Unlike the seeds, they were not so dehydrated and concentrated and not therefore so transportable, though the early Peruvians did in fact cut up their potatoes into little crisps and dry them in the sun.

That was the first big stage in the utilisation of seeds by man, leading to easy travel and a settled home.

The second stage was the planting of a garden. Now a garden of trees entails long forethought, with its rewards not always in the generation that planted it, but a garden of grain could yield its returns in eight months or less. Early man would bring home from

his travels bigger and better grain, he would watch stray grains grow on his rubbish heap, he would encourage them to grow on specially selected ground, and so he would establish the beginnings of a garden. We can still see the effects of their travel and of their gardening; in Africa the smaller-grain millets have been supplemented and replaced by larger-grain sorghum millets from India; in Europe the original wheat with two rows of grains has been almost entirely replaced by wheats with six rows of grains.

Now the maintenance of a garden entails two new attitudes - forethought for the lean non-productive months, and inventiveness for the best uses of the products of one's labours. This brings us to our third stage. Man not only grew, and harvested, but stored his food. He selected grains that would not shed their seeds prematurely on the ground, but remained on their stalks where they could safely be gathered. He found out means to select his grain and to process it - removing the scaly chaff by threshing and winnowing, taking off the indigestible outer husk by pounding it, making it tastier by mixing with water to a paste, by adding salt, and finally by baking it in a convenient bushland fire.

Such a mixture produced an edible kind of cake, but still a rather heavy one, and it wa1; not until about 5,000 years or so ago that man located or bred a most useful non-green plant of microscopic size - the yeast. This small organism, and some of its wild precursors, can produce from a starchy and subsequently sugary paste, two things useful to man, alcohol and carbon dioxide. From one operation on a starchy grain paste, ma" could now produce two commodities, a palatable and stimulating drink, and a light dough for a leavened bread. Now also he grew other plants, fibre plants to make a roof and clothing, plants for his medicine and plants for his magic.

From all these stages in progress came finally the settled community, the family, the tribe, the nation. Men began to own property, their gardens and their wives, and the land itself became that of his tribe. All this development entails the elements of government and the beginnings of economics.

Now it became possible for these men of substance to look about them, and they did. They made little boats and crossed the rivers and sailed the lakes; they made larger boats and ventured on the oceans, and after a long time-gap of several thousand years, there came a period of the large-scale mobility of man with his horses on land, and his ships on the seas: the explorers, the settlers, the soldiers, the traders and the missionaries all moved about until they finally knew the whole earth. As they moved, they took with them their home animals and their home plants as food for their journeyings, as stock for the islands and the harbours where they might call again on another voyage.

They went to look for new lands, for treasures, for marvels, for special new foods and particularly for spices. Seven hundred years or so ago, Marco Polo came back from his voyages to China with a tale of wonderful "vegetable lamb," a plant bearing a fruit with wool around its seeds; this we now cultivate as cotton. In the flotilla of Captain Drake there was a Captain Winter who is still remembered by the medicinal tree he discovered, Winter's Bark. The name of the Bougainvillea plant commemorates that Captain who preceded Captain Cook in the Pacific in 1767 and whose ship's naturalist, Commerson, discovered it in Rio de Janeiro.

We can tell where these men went, even without the written records, by the plants they left behind them; there are European oats - and goats - in the islands of the Galapagos. We can also tell where these travellers came from by the weeds they took along with them inadvertently, in their seed stores, in their bedding and their animals' fodder. Almost 500 years have gone by since large movement of man started; the changes this has caused in the places where plants grow can be assessed by looking at a basket of food plants bought in the market places of Malawi. The banana comes from the Polynesian islands, the maize from Central America, rice and the citrus fruit~ from south-east Asia, mangoes and the larger millets from India, and pineapples and avocadoes from South America. What therefore can we count on that is really indigenous to central tropical Africa? Some millets, some beans, and especially that most important. food item, the water melon. The food markets of the tropical world are becoming common markets.

Nor is this all. Plants have long been sought after by man for their beauty alone, an<;l such ornamental plants have been transported about the world so freely that much 01 the world, especially the tropical world, has become a kind of international pleasure garden. These of course were deliberately transported, but other plants have come in too, brought in unwittingly. These are the weeds. In some countries they have established themselves so successfully that they have become pests. Just as with the food plants, so with the weeds, we can trace the movements of the men who brought them. In Malawi the little sensitive plant *Mimosa pudica* comes from Brazil, brought by the Portuguese who called at the northeastern tip of Brazil on their way to the Cape of Good Hope and India. The prickly yellow poppy (*Argemone mexicana*) comes from Mexico; the Nilghiri Daisy is thought to have been introduced with the tea plants, and the yellow Sowthistle (*Sonchus arvensis*) is of northern European origin.

By contrast, Central African plants have found their way to other lands - food plants such as the water melon, ornamental plants such as the white Bauhinia, the fringed Hibiscus (*H. schizopetalum*) and the scarlet *Erythrina*. The little red-flowered witchweed (*Striga*) of tropical Africa has now become a pest of maize plantations in the southern United States.

Now we come to the final stage in our survey of plants in relation to mankind, a survey that will make a chapter in some other story .This would be a survey of man engaging in fundamental botanical research, man breeding new varieties of food and crop plants in the laboratory, man controlling such crops in the field, and man controlling his environment by the crops he plants not only for immediate yield, but for control of erosion and conservation of the soil. All these entail deep investigation and long research. When once the frontiers of such knowledge have been crossed by the coming young biologists of the country, we may look to them to establish and develop even farther, the close relationship between plants and mankind.