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# Soil Erosion: The Growth of the Desert in Africa and Elsewhere*

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It is a commonplace of geology that the surface of the earth is constantly in motion; that our mountain ranges have taken shape and our river courses and valleys have been excavated by rain, frost and wind. In many parts of the world this movement of the soil surface is taking place rapidly, with serious consequences to the agriculture of those countries, owing to soil erosion.

The soil is dependent for its stability on its normal covering of vegetation, but as a rule the soil proper is not more than 6 inches to a foot deep, and it is in the surface layer that the fertility resides. There is thus always a danger that if the cover of vegetation is removed, the soil itself may shift under the action of either wind or rain. The earliest cases of erosion caused by such movement of the soil are those which follow deforestation in regions where the mountains in which the rivers take their rise are below the permanent snow line—*e.g.*, in the eastern Mediterranean. There is no evidence in support of the belief that forests increase the rainfall of a country; indeed, by the transpiration from their leaves, they must reduce the total amount of the rainfall retained by the soil, but they serve as its regulator; as the rain falls, it is absorbed by the spongy soil below the trees, rich in humus, and reappears later in the springs and rivers when the rainy season is over. Too commonly, however, the forests have been cut down without regard to their regeneration, both for the value of their timber and for a desire to extend the grazing land.

The grazing animals themselves do further damage, especially if they are goats: not only do they destroy every seedling tree, but they tread hard paths down which the rain runs with gathering volume and increasing velocity, gradually forming gullies, until in a generation or two the hillside gets bared down to the hard, infertile subsoil. Nor does the damage end there. The rainfall, running off without a check, develops into a torrent and eats into the meadows bordering on its course. The earth that has been torn away is carried down to the plains, where it is deposited, and turns the river into a chain of malarious swamps. Similar phenomena can be seen in the new countries opened up in the nineteenth century: forests were destroyed, and rivers have become subject to violent flooding.

Another form of soil erosin which is perhaps even more spectacular is that exhibited by the vast duststorms, such as those which in 1934 swept over the United States east of the Mississippi. In Canada also wind erosion has occurred on a disastrous scale. The causes are easy to discern. This form of erosion occurs only in comparatively arid districts with an annual rainfall below 20 inches, and usually where the fundamental subsoil is of a sandy type. In America before white settlement, these regions were covered with grass: some of the land was good grazing, with a fair depth of rich soil, but in the drier parts the sod was thin and there were only a few inches of soil. At first this poorer land was kept for grazing, but when the price of cereals rose rapidly from 1917 onwards farmers began to extend to them the area under plough. The system of farming was of a wasteful type; the straw was burnt, no stock was kept, and very few years with no recuperative crop were enough to exhaust the limited stock of humus. When years of drought came: the light soil, no longer bound

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together by either vegetation or humus, began to drift in the fierce winds that sweep over those great plains. The plough had destroyed the binding power of the soil, and the whole of the fertile top layer was swept away.

The methods practised by the pioneers in the development of a new country are rarely those of sound agriculture, but merely a form of shifting cultivation. Many European soils have been cultivated for a thousand years or more without showing any decrease in production, by the application of sound agricultural practice, while in China intensive cultivation has been maintained perhaps for four thousand years without soil erosion or loss of fertility.

In recent years where the danger of soil drifting is acute, means of cultivation have been introduced to minimize the risk. In some places the land has been divided into strips, bare land alternating with land under crop, in place of the former large areas under the same treatment. Incipient soil erosion through wind is in this way checked b fore it can proceed far. Another practice is to establish shelter belts to break the winds, though in some of the districts where wind erosion is worse—such as Saskatchewan and Alberta—it is no easy matter to find species that will stand up to the extremes of climate.

Erosion through wind, as described above, is worst on the flat plains, but erosion by rain is more common where the cultivated land is on a slope. In such parts the danger does not lie in a large annual rainfall, for that will as a rule generate a forest vegetation which protects the soil; it is the sudden heavy rainfall which causes most damage. Cultivated land on a slope may suffer from erosion by water of two kinds: (*a*) a continuous slow removal of the good soil (sheet erosion) and (*b*) a catastrophic wash-out (gullying). As preventive measures the slopes can be terraced and cultivated along the contours. The object of this is to enable the soil to absorb the rain as it falls without allowing it to set up a flow over the surface, but it may be necessary to break the terraces at intervals with spillways to lead accumulated water into drains or watercourses. Alternatively, belts of unploughed vegetation may be left to break a run-off. By such means, coupled with the growth of a leguminous plant which can be dug in to add nitrogen and humus to the soil, planters in tropical countries have been able to check erosion even where the rainfall is excessive. Such a system of contour terracing has been practised in China from time immemorial.

But wherever torrential rains occur there is always a danger of gullies being started in the bare soil. Gullying can be initiated either by careless methods of soil management or, on grassland, by over-grazing which bares the surface. In the early stages such gullying can be checked by throwing dams across the gash made of anything that will hold up the rush of water and cause the sediment to accumulate. Even more effective has been the introduction of rapidly growing vegetation—*e. g.*, Kudzu (*Pueraria thumbergiana hirsuta*), a creeping leguminous plant which not only checks the flow of water and filters out the silt, but binds the earth and at the same time gathers nitrogen.

The examples of erosion hitherto described are those that are due to unthinking exploitations of the soil by civilized man. Consideration should also be given, however, to what is taking place in Africa under native systems of farming. In the first place, it must be realized that whereas European farming is essentially founded upon a rotation of crops, in which a recuperative leguminous crop finds a place and in which livestock play their part in converting into manure those parts of the crops, such as straw, which are not valuable for human food, together with grass and other rough fodder, the African tribes, on the other hand, are for the most part still in the more primitive stage of "shifting cultivation." Under this practice the cultivator clears a plot of land, perhaps burning off the timber, before putting in his food crops. After two or three

years of continuous cultivation the soil begins to become exhausted, and when that takes place and weeds become intractable, the plot is abandoned and a new piece of land is taken up. The abandoned plot in course of time recovers sufficiently to be taken into cultivation again, but under this system a tribe requires several times as much land as is actually under cultivation at any one time.

Another point of great importance is that the Bantu tribes, which predominate in east Africa, attach the greatest value to cattle, which represent wealth and position, but serve little or no economic purpose. They are not eaten, except ceremonially; by many tribes they are not milked; they are not beasts of burden, and their dung is not used as manure. At the same time every native is anxious to increase the number he owns, for on that depends his position in the tribe.

Within the past century, since British rule has maintained peace, the human population has increased very markedly, and this increase has been accompanied by an even greater increase in the numbers of livestock. The animal population has far outstripped the means of sustenance and is destroying vegetation in uncultivated areas which ought to be recuperating in readiness to be brought into cultivation again. The Kenya Land Commission, reporting in 1923, stated that "Probably about the year 1920 the main stock areas of the native reserves had attained their optimum carrying capacity, and although fully stocked were not overstocked." Since that time the cattle population has roughly doubled itself. Through presistent over-grazing, the ground has been beaten hard into little paths, even where it has not been eaten bare, and thus large areas have been laid open to erosion from rain, especially on the hillsides. Under cultivation, the humus of the soil rapidly becomes exhausted; the climate produces recurrent periods of drought followed by rainfall of fierce intensity, with a result that soil erosion, widespread and disastrous, occurs. Furthermore, the native population not only practises a destructive and wasteful form of agriculture but, as already mentioned, keeps a vast uneconomic herd of cattle including the devastating goat in large numbers. It is small wonder that famine is never far away from some of the tribes, and if this is to be avoided the native must either change his methods or limit his numbers. African soil was never rich, and soil erosion has been developing for years without attracting much notice, but has now reached the stage where the growth of the desert may speed up catastrophically.

It is only recently that the dangers of erosion in Africa have been realized. The problem and the means of attacking it have, however, occupied increasingly prominent places in various Government reports since 1929, and it is now evident from Sir Frank Stockdale's report on his tour through Africa this year that all the African colonies have become erosion conscious.

Much yet remains to be done before the arrears of years of misuse of the soil can be repaired, and before the native population can be educated to systems of farming which will maintain the fertility of the land. Drastic changes in native custom will need to be brought about, and in many cases expenditure will be called for which can hardly be found within the limited resources of a particular colony.

The regeneration of wasted lands must begin with closing them for a time to grazing, so as to allow the return of natural vegetation. A certain amount of minor engineering is needed to check run-offs and dongas by dams and plantations. At the same time, cultivators must be taught the virtues of contour ploughing and planting and of vegetation strips in cultivated land.

Such measures, however, do not touch the major causes of erosion—*i. e.*, overstocking. To combat this, legislation is necessary with a view to compelling

a reduction in the number of cattle. This must be done by way of purchase, and since the animals discarded would at first be practically valueless for food, factories would be required to turn the carcasses into fertilizer, and, later, into successively better products as the quality of the cattle dealt with improved. A reduction in the number of cattle or sheep to one-half would not only relieve the pressure on the land, but would give the native owners some chance of improving the quality of their livestock, both by selection and better feeding; whereas at present numbers only are valued. Education should also be the means of inducing the natives to use cattle economically for milk or meat and for traction, or at least to sell them for food. One cannot escape from the fact however, that forcible limitation of the number of cattle a man may hold will be a grave interference not only with tribal custom, but also with the dignity of individuals. One idea which has its attractions is that a special token currency should be introduced for the purchase of native livestock that would constitute a visible display of wealth and status.

Even more fundamental must be the education of the natives in the adoption of a conservative system of farming—a rotation that would include the leguminous crops, and thus help the native dietary as well as restore nitrogen to the soil. Already compost making is another means of maintaining fertility that is being taught to the natives. The African cannot increase or even maintain his present numbers unless he learns how to use his plot of land so that it will continuously produce food. Demonstrations have shown how it can be done but it will need both a strengthening of the agricultural staff and years of effort before the improved practices are taken up. Effort in all these directions on a large scale is an urgent necessity. Many of the tribes are on the verge of starvation, the desert is growing apace, and as the cropping or grazing area shrinks the pressure upon it becomes greater and destruction proceeds at a compound interest rate. Responsibility for action must lie not only on the colonial Governments, but on the British Government itself, which has declared itself trustee for the native populations and must save them from themselves.

(*The Empire Cotton Growing Review*—January 1938)

# Research Notes.

### Jassids on Cotton.

Two species of Jassids are found on Cambodia, Uppam and Karunganni cottons; one is *Empoasca devastens*, Dist. and the other *E. formosana*, Paoli. The former is the commoner and more abundant, and is recognisable by a pair of black dots, one on each of the apical end of the tegmen; the latter occurs in sparse numbers and can be distinguished by the faint brown patches on the wings and the absence of black dots.

Both the nymphs and adults feed on the leaves from underside by sucking the plant sap with the aid of their stylet like proboscis. Severe infestation by the jassids adversely affects the growth of plants. Young seedlings may succumb and older plants become stunted in growth. The curling down of the margins of the leaves, development of red lesions along the upper margins and the chlorotic and cream coloured patches on the underside are the chief symptoms of jassid infestation.

Jassids are found in the field from October onwards and seem to reach the peak in December and January; thereafter they show a tendency to go down; in April and May their population is very light and sparse. The warm weather appears to have something to do with the decrease in their numbers.