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### GRASSES, AND THE EVOLUTION OF LIFE.

As a comparison of the apparently trivial with the obviously great and spectacular, the following remarks by the President of the British Association, 1935 (Professor W. W. Watts, F.R.S.) in his Presidential Address are given :

Evolution of life on the earth has been by no means uniform ; there have been periods of waxing and waning which may be attributed to geographical, climatological, and biological influences. The development of large land areas, ranged longitudinally or latitudinally, the invasion of epi-continental seas, the isolation of mediterraneans or inland seas, the splitting of continental areas into archipelagos or the reunion of islands into continuous land, the making of barriers by the rearing of mountain chains or the formation of straits or arms of the sea, the oncoming of desert or glacial climates ; all such factors and many others have been of importance in quickening or checking competition, and in accelerating or retarding the evolution of life.

Probably, however, even greater effects have followed the interaction of groups of biological changes on one another. As an example I might recall Starkie Gardner's estimate of the results following upon the first appearance of grasses in the world. This seems to have been not earlier than Eocene, and probably late Eocene times. By the Oligocene they had made good their hold, peculiarities in their growth and structure enabling them to compete with the other vegetation that then existed ; and gradually they spread over huge areas of the earth's surface, formerly occupied by marsh, scrub and forest. They have, as Ruskin says, " a very little strength . . . and a few delicate long lines meeting at a point . . . made, as it seems, only to be trodden on today, and tomorrow to be cast into the oven " ; but, through their easy growth, their disregard of trampling and grazing, and by reason of the nourishment concentrated in their seeds, they provided an ideal and plentiful source of food.

On the establishment of the grasses, we find that groups of animals, which had previously browsed on shrubs and trees, adopted them, with consequent alterations and adaptations in their teeth and other bodily structures. To follow their food from over-grazed or sun-scorched regions they required to be able to migrate easily and quickly, and it was essential for them to discard sedentary defence and to flee from threatened danger. Such defence as was possible with heels, teeth or horns they

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prevent losses in commercial crops. It has been found possible in some instances to upset the correlation of an insect pest with its host plant by altering the sowing dates of crops or by the use of early or late varieties, or by stimulating or retarding the growth of the vegetative or reproductive portions of the plant by the use of various manures. It has even been found possible to render a plant completely immune from the attack of a particular pest by providing an abundance of a certain chemical in the soil. Considerable advances have also been made in the selection of varieties of plants naturally resistant to the attacks of specific pests. Again a slight artificial alteration in the pH of the soil has been shown greatly to reduce the reproductive powers of certain pests which ingest soil. (A series of lantern slides was shown illustrating methods of control of specific pests by the above means.) Some most striking advances have also been made in the study of plague locusts and grasshoppers in recent years, and considerable light has been thrown on the causes underlying the outbreaks of plague locusts which occur at irregular intervals in many parts of the world.<sup>1</sup> (A series of slides was shown illustrating the bionomics of plague grasshoppers, with particular reference to the "phase theory" and to outbreaks of plague grasshoppers in Australia.)

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retained ; but the dominant modifications in their organisation were in the direction of speed as their vital need.

Side by side with this development, and in answer to increasing numbers, came bigger, stronger and speedier carnivores, to feed on prey now so much more abundant, but more difficult to catch. The answer of the grass-feeders, with their specialised hoofs, teeth and bones, better suited to flight than fight, was to seek safety in numbers, and thus develop the herd instinct, with its necessity for leadership and discipline ; but this, in turn, provoked a like rejoinder from some types of their enemies.

When it is remembered how much of the meat and drink and life of mankind is bound up with the grasses, including wheat, maize, millet and other grains, sugar-cane, rice and bamboo, we must realise how close is his link with the development just outlined. Practically his whole food supply is provided by them, either directly by the agriculturist who grows little else but grasses, or indirectly by the herdsman whose domestic animals are fed chiefly on the same food. Nor must we forget that almost every one of our domesticated animals has been derived from the gregarious types just mentioned, which have accepted the leadership of man in place of that of their own species.

It is perhaps not too much to say that the magnificent outburst of energy put out by the earth in the erection of the Alps, Andes and Himalayas in Tertiary times, was trivial in its influence for man's advent and his successful occupation of the earth in comparison with the gentle but insidious growth of "mere unconquerable grass" and its green carpet of "wise turf", which in some form clothes by far the greater part of the land of the globe.

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<sup>1</sup> N.B.—The term locust is only correctly applied to grasshoppers of the family Acrididæ, the local use of the term for cicadas being most confusing.