■ Man's power to control nature is ever growing and to the advantage of mankind.

BIOLOGY AND OUR FUTURE WORLD

The balance of nature is a very elaborate and very delicate system of checks and counterchecks. It is continually being altered as climates change and new organisms evolve. But in the past the alterations have been slow, whereas with the arrival of man their speed has been multiplied many fold.

Agriculture is the chief of man's efforts at the biological remodeling of nature. If we reflect that agriculture is less than a paltry 10,000 years old out of 300,000,000 years that green plants have been on earth, we begin to grasp something of the revolution brought by this biological discovery.

But agriculture is, if you like, unnatural; it concentrates innumerable individuals as a single species — and always of course, a particularly nutritious one — into serried ranks, while nature's method is to divide up the space among numerous competing or complementary kinds. Thus it constitutes not merely an opportunity but a veritable invitation to vegetable-feeding animals, of which the most difficult to control are the small, insinuating, and rapidly multiplying insects. And the better and more intensive the agriculture, the more obvious the invitation. Mile upon square mile of tender, well-weeded wheat or tea or cotton offers the optimum possibilities for the rapid multiplication of any species of insect which can take advantage of man's good nature toward his kind.

Finally, man's insatiable desire for rapid and easy transit has capped the trouble. By accident or intention, animals and plant species find their way along the trade routes to new countries. They are in a new environment, and in such circumstances the majority fail to gain a foothold at all; but a few find in the new circumstances a release instead

of a hindrance, and multiply beyond measure.

Then it is up to the biologist to see what he can do. Sometimes, by studying the pest in its original home, he can discover what are the species that normally act as checks on its overmultiplication. Thus in Fiji, when the valuable coconut industry was threatened by a little moth — very beautiful, with violet wings — those grubs devoured the leaves of the palm trees, biologists searched the remote corners of the Pacific for a parasitic fly. This fly quickly reduced the menace to the status of a minor nuisance. And in Australia, when prickly pear — first introduced into the country as pot cacti for lonely settlers' wives — increased so prodigiously that it was covering the land with impenetrable scrub at the rate of an acre a minute, biologists sent out a mixed team to fight it: a caterpillar to tunnel through the "leaves," a plant bug and a cochineal insect to suck its juices, and a mite to scarify its surface. There were the Four Anthropods of the prickly pear's Apocalypse; and the thickets are melting away under the combined attack.

One could multiply instances. How the sugar cane of Hawaii was saved from its weevil destroyers; how an attack is being launched upon the mealy-bugs that are such a pest to Kenya coffee by massed battalions of lady-birds. To cope with all the demands for anti-pest organisms a veritable industry has sprung up.

The difficulties of such work are far more severe when the pest is an old-established inhabitant of the country. Problems of this type are set for us by malaria, spread by indigenous mosquitoes; human sleeping sickness and nagana disease of cattle, transmitted by tsetse-flies; plague, dependent for its spread upon the ubiquitous rat. In some parts of Africa the issue is whether man or the fly shall dominate the country. Here the remedy seems to be to alter the whole environment. Most tsetse-flies live in bush country. They cannot exist either in quite open country or in cultivated land or in dense woodland or forest. So that wholesale clearing

or afforestation may get rid of them.

That pests of this nature can cease to be serious is shown by the history of malaria and of plague. In various parts of Europe and America, these diseases, once serious, have wholly or virtually died out. And this has happened through a change in human environment and human habits. Take plague. Modern man builds better houses, clears away more garbage, segregates cases of infectious diseases, is less tolerant of dirt and parasites and, in fine, lives in such a way that his life is not in such close contact with that of rats. The result has been that rats have fewer chances of transmitting plague to man, and that the disease, if once transmitted, has less chance of spreading. With regard to malaria, agricultural drainage, cleanliness, and better general resistance have in many cases done as much or more than deliberate anti-mosquito campaigns.

There is still another angle from which we can attack our problems. For instance, instead of trying to attack a pest by means of introducing enemies, or altering the environment, we can often deliberately breed stocks which shall be resistant to the attacks of the pest. Thus we can now produce relatively rust-proof wheat; and the Dutch have given us spectacular examples of what can be accomplished by crossing a high-yielding but disease-susceptible sugar cane with a related wild species which is disease-resistant and, in spite of the fact that the wild parent contains no trace of sugar, extracting from the cross after a few generations a disease-resistant plant with an exceptionally high yield of sugar.

Thus science offers the prospect of the most radical transformation of our environment. Cows or sheep, rubber-plants or beets represent from one aspect just so many living machines, designed to transform raw material into finished products available for man's use. And their machinery can be improved. Modern wheats yield several times as much per acre as unimproved varieties. Modern cows grow about twice as fast as the cat-

tle kept by semi-savage tribes, and when they are grown produce two or three times as much milk in a year. This has thrown a new strain on the pastures; for if the cow eventually draws its nourishment out of the soil, and if the animal machine for utilizing grass is improved, the plant machine which is responsible for the first stage of the process, of working up raw materials out of earth and air, must be improved correspondingly. Accordingly research is trying to manufacture new breeds of grass which shall be as much more efficient than ordinary grass as a modern dairy beast is than the aboriginal cow.

These few examples must suffice to show the kind of control which man is just realizing he could exert over his environment. But they are enough to give us a new picture — the picture of a world controlled by man. It will never be fully controlled, but the future control of man will enormously exceed his present powers. The world will be parceled out into what is needed for crops, what for forests, what for gardens and parks and games, what for the preservation of wild nature; what grows on any part of the land's surface will grow there because of the conscious decision of man; and many kinds of animals and plants will owe not merely the fact that they are allowed to grow and exist, but their characteristics and their very nature, to human control. — *Condensed from Harper's Magazine,* (1932) *by Julian Huxley, British biologist.*