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IN PRAISE OF PARASITISM

SUMMARY¹

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Parasitism in the biological sense may be broadly defined as a condition of intimate association between two organisms, i.e., living entities, in which one organism, the parasite, lives on or in the other, i.e., the host, and derives a part or all of its food from that host. Such a definition includes the phenomena of saprophytism, where the dead remains of the host are the source of food. It includes, at the other extreme, phenomena of symbiosis, a derivation of parasitism in which the two interdependent organisms appear to be mutually beneficial. The essential feature common to this wide range of phenomena is a nutritional interdependence.

The morphologic degeneration commonly attributed to parasites is a false emphasis on what is actually a simplification of structure, an economy of effort, and an accurate adaptation to the interdependent relationship, and is often accompanied by increased physiologic complexity.

Parasitism is as old as the oldest of living organisms now known to man—as illustrated by the bacteria, where parasitism is still a dominant habit. Perhaps the outstanding specialists in parasitism are the fungi, which exhibit an almost limitless variety of form, habitat, range, and habit and which still after millions of years of evolution constitute one of the most numerous and successful groups of organisms. Higher plants, such as mistletoes and dodders, Indian pipes and orchids, have here and there adopted parasitism in some form of dependent nutrition.

Living substance is characterized chiefly by an autonomous and continuous set of chemical and physical reactions which, in the individual, result in growth and through the germ cells result in racial continuity. Death has apparently become the concomitant or inevitable result of individualization. Chiefly by parasitism, as a dependent nutritional habit, is this dead material restored to form available for future organisms. The scavenger service of parasitism is incalculable in its effect. Without it our organic world would be inconceivably different from that which we know. This reconditioning of food materials locked up in pre-existing organisms prolongs the available food supply of organic life on the earth. By the interrelation of autophytism and parasitism our organic life may become essentially a continuous catalytic process in the reconstitution of the earth's solid rocks.

All animals, including man, are nutritionally dependent, in the last analysis, on plants—and therefore essentially parasitic in habit. Their evolutionary achievements, even though not, perhaps, pri-

¹ Entire paper to be published in *The Scientific Monthly*.

marily due to this habit, have not been inconsistent with that habit. They have the advantage of starting with an already manufactured food supply.

Perhaps the greatest achievements of parasitism in the evolution of organic life, both plant and animal, are found in intergenerational parasitism. These achievements have made possible mammalia, the highest of animals, and the seed plants, the dominant aristocrats of the plant kingdom.

In the evolution of seed plants such an intergenerational relationship has appeared twice and has made possible the modern seed. The first, older even than the mosses, is the dependence or parasitism of sporophyte on gametophyte. It resulted, in the mosses, in permanent dependence of sporophyte on gametophyte, was restricted to infancy of sporophyte in ferns, and has persisted in the seed in the nutritional dependence of seed plant on endosperm. The second, viz., a later developed dependence of gametophyte on sporophyte, resulting in the dependence or parasitism of endosperm in and on the seed plant ovule, the final step in the culmination of the seed of modern seed plants.

Finally, in the mammalia, prenatal nutritional dependence or parasitism of the fetus on the mother has made possible during the fetal period more and greater morphological changes in the growth of the human individual than are consummated in the entire life after birth. The prolongation of infancy in post-natal life of man has resulted in social dependence, such as infant care, elementary, secondary, and college education, and other social customs.

Parasitism, then, has been not merely a destructive force but also a great constructive force in the evolution of life on our planet.

"To organic life as expressed in the higher plants and animals of today, the menace of the complete exhaustion of available food is real. Parasitism in its destructive capacity is a check on the unlimited use and waste of that available food, and in its constructive capacity it is the reclamation of new food materials from the locked storehouses of organic products. Without that parasitism it seems inevitable that these higher plants and animals must approach extinction through increasing unavailability of food materials. It is even conceivable that without that parasitism, organic evolution may come to an abrupt end by the complete exhaustion of food materials. Because of that parasitism organic evolution may approach a succession of building up and tearing down processes that are limited only by the ingenuity of living substance in devising forms of social and individual parasitisms. Living substance may become merely the catalyst in the reconstitution of the earth's solid rocks. But that ever progressing catalysis is dependent not merely on the utilization of the rugged individualism of the autophyte but equally upon the restoration and reclamation of used materials to continued use. I am almost persuaded that parasitism is the great hope of future organic evolution."