CONCLUSION

From the standpoint here adopted, differentiation is the expression of internal as well as external specificities. It is a cytoplasmic reaction and when it occurs denotes that something is not as it was before. Here as elsewhere, we do not deal with isolated events, but correlative changes with specific antecedents and specific consequences. This linkage of specified happenings persists through the entire life-cycle but in the adult, having few or relatively unimportant morphogenetic results, constitutes the basis for a physiology of maintenance.

In development as well as maintenance, that which constitutes our problem is a harmonic relation among all the processes whose net result makes possible the identification not only of an organism at any stage of life, but also of its ancestors. Such constancy, maintained despite the bewildering complexity and multiplicity of processes, is thinkable only in terms of the most rigid determinism.

The results of destroying portions of an embryo, the restoration of lost parts, heteromorphoses, the development of entire organisms from egg-fragments, grafting, the reorganization of an individual from its disjointed cells, and the fluidity of certain types of behavior, are in no sense counter arguments. All that these show is that the equilibria within which specificity is possible, have a certain range. When the eye-stalk of a crustacean regenerates, not an eye, which it does only under certain circumstances, but an antenna, the antenna is species-true, and when the stump grows an eye, which it does under circumstances of a different sort, but no less specific, the eye is not that of a man or an octopus.

If the developmental history of an individual yields a result from which his ancestry can be inferred, what other proof is needed for the accuracy of all the underlying processes? And what need have we who can think through our problems in materialistic terms for regulatory interference by metaphysical vapors? Far from making these things easier to understand, the table-rappings of the vitalist only withdraw attention from the one basis on which we can hope, at present, for a scientific account of the individual at all.

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THE NECESSITY FOR BIOLOGICAL BASES FOR LEGISLATION AND PRACTISE IN THE FISHERIES INDUSTRIES

It is lack of knowledge of the world he lives in that makes civilized man an actual catastrophe to nature's resources and methods.

In this, as in every new country, earlier generations began a series of stupendous economic blunders of turning into cash every natural asset available, blindly regardless of future necessities. Public assets have been, and in some instances are still, legitimate private booty for those whose imagination may be sufficiently keen to see the gold dollar hidden there. It is only within recent years that evidence has accumulated of the imperative necessity of developing the converse method of solving the economic problems of how best to transform free public goods, *e. g.*, lands, minerals, forests, water power, aquatic life, wild birds and quadrupeds, and scenery, into private property or adequately safeguarded public assets. The problem itself is of huge proportions and extensive in its ramifications. We are only beginning to grasp its fundamentalness and to awaken to the extent of our failure to find the correct solution. We still need a system of education which enables the child, the teacher, the parent, the state and federal legislator better to acquire the fundamental facts and their bearings upon human life and human progress. This alone would have made improbable, if not impossible, the present status where in some respects, in any

event, we are dangerously approaching biological bankruptcy and a condition which if not speedily mended will become more speedily beyond recourse. Even over and beyond such earlier blunders as our methods of distribution and alienation of such national assets as the public agricultural domain, mineral and forest lands, the inconceivable slaughter of the wandering herds of buffalo, elk, antelope and deer, of the clouds of migratory birds on land and the fleets of fish, birds and mammals swimming in the sea, much of the capital of this national wealth has been unwisely turned into cash and reinvested in less stable and permanent form of property, and vast sums put into non-productive and depreciating forms of property. To render the future secure, a considerable portion of the primary proceeds must be again converted back into the original form of investment in nature's laboratory. When obliged to do this we see how difficult and costly, even if not impossible, is the process, and how woefully the capital has shrunk as a result of ignorant and selfish manipulation.

An illustration in a very broad sense is our usual method of dealing with our rivers and streams. The fundamental law of water is that a stream may be used, but in such a manner as not to impair its value to property on the stream below. Yet "civilized" man's first conception of a natural stream is that of a sewer, provided by nature for use as such by municipalities, corporations and individuals. The ocean is falsely regarded as the proper ultimate receptacle of all sorts of material débris of civilization. The next generation will be convinced that vast sums have been unwisely expended in construction of "trunk lines of sewers to the ocean," not to mention the cost to the state of the legislation necessary, or of the prodigious waste of nitrogenous material which is diverted from its immediate useful purpose of nourishing vegetation on land, and the irrevocable loss of other valuable recoverable materials valuable in manufacturing and in the arts.

The immediate effects, however, of the biologically and economically indefensible present methods of disposal of manufacturing and municipal wastes are destruction of fish life and menaces to the public health. I am of the opinion that the annual waste of such materials in the little state of Massachusetts alone results in the loss of at least $3,000,000 each year to the manufacturers and citizens in substances recoverable at a relatively small cost. In addition in that state at least $1,000,000 in potential food value could be annually produced in water now for that purpose made valueless or worse, by pollution. There can be no doubt that the present unsatisfactory conditions in the oyster and fish business in general are due to the false impressions of the sanitary condition of fish and shell fish conveyed to the public mind by the appearance of the shores as a result of our indefensible practises in the disposal of municipal and trade waters.

All this is directly connected with our failure to correlate our practises, whether federal, state, municipal or individual, with the essential basic biological principles. Methods and constructions must ultimately be devised and executed to check this vast waste.

As a nation and as individuals we have failed to recognize and to utilize in adequate measure the necessary and correct biological bases for legislation, and though a beginning has been made in many federal departments, including notably among others the Department of Agriculture and the Bureau of Fisheries, progress elsewhere is still retarded and handicapped by unfortunate precedents, by prevalence of local or merely transient expediencies by amateur "near-statesmen" and by personal opinions forcibly expounded by those who have more enthusiasm or authority than special information or training. In general our state and federal governments are open to severe arraignment for obvious failure to equitably and readily secure, to meet required increased production, the transformation into property of those free goods still held in that type of primitive communism which was possible before the development of an increasing population. With reckless haste and too frequently dangerously close to corrupt methods, we have seen the conversion into private wealth of such public assets as not only the forests, fish, birds and quadru-

peds, the products of land and water, but as well much of the public domain itself, both land and water, the agricultural, timber and mineral lands, the sea shores and the lands under water inside the three-mile limit, etc., directly or by indirection, with the result that we have changed the forms of our investment, destroyed nature's perennial dividend producer, only to find after trial on other lines that we must restore nature's plant and methods, be content to assist nature, and to be satisfied with smaller, though more regular increment. The tendency is to replace, frequently at public expense, what the lethargy of the people has permitted to be destructively turned into private property. We burn our forests, then laboriously replant them. We destroy the native birds, and import foreign species to replace them, and even then are compelled to resort to expensive spraying operations to check insect depredations which under natural conditions would have been controlled in considerable measure by birds. We pollute our sources of drinking water, and then devise costly and sometimes ineffective methods of purification. We poison our rivers, and import food fish from wiser nations, or spend our money for outdoor recreation in more far-sighted communities.

Many of the major abuses have happily now come within the public view and into line for ultimate correction. There remain, however, many minor abuses, similar in that they have arisen from the same causes as have the major ones, viz., the personal acquisitive habits of man. These abuses menace the usefulness, even the existence, of many important public assets because in addition they include an underlying biological fallacy which escaped the notice of the legislators. A biological joker in a legislative bill is sometimes more difficult to deal with than the proverbial "colored gentleman in the pile of ligneous fuel" and is a more certain source of trouble. The most prominent weakness in original legislation dealing with wild life, whether fish, birds or quadrupeds, is the too great emphasis upon "don't." Restrictive legislation, piled Pelion on Ossa, at enormous waste of energy and time, frequently fails to meet expectations, for the reason that it usually ignores the question of increased production. It restricts the demand without increasing the supply. In general, for example, legislation restricting the time (close seasons) and manner of taking, unless closely connected with the breeding habits of such species as can not be readily propagated artificially and thereby made independent of the natural conditions necessary for existence, fails to be effective, in that in many cases they do not increase the supply in proportion to the restriction upon demand. The true method is to increase the annual production by bringing about conditions which augment the number of eggs or young produced and brought to maturity, by minimizing the enemies which prey upon young and adults, by improving the feeding conditions, inducing more rapid growth or improved qualities. Both the terrestrial and aquatic conditions are closely similar and require practically identical treatment. We more quickly, however, detect changing conditions on land and apply the proper remedy without loss of time.

The Pilgrim Fathers had scarcely become fairly settled at Plymouth, where fish were so abundant that it was "enacted by the Court, that six score and 12 fishes shall be accounted to the 100 of all sorts of fishes," before establishing by Article 8 of the laws of 1623, that principle of public rights which has opened at once the wealth of Croesus and given opportunities to the modern Aeolus of legislative bodies, that "fowling, fishing and hunting be free to all inhabitants of this government, provided, that all the orders from time to time made by the General Court for the due regulation of fishing and fowling be observed in place or places wherein special interest and property is justly claimed by the Court or any particular person."

This marks the beginning in this country of the principle of primitive communism which had a basis in genuine altruism, and which beyond doubt then met existing conditions, as seen by those who could not forecast the future and whose mental point of view and horizon was obstructed by unfortunate experiences across the sea.

Present conditions, however, render imperative a modification of this view. Restrictive legislation which is the logical concomitant of this primitive communism, no longer meets the situation. Agriculture has passed through this stage of evolution, into which the fisheries, the wild birds and quadrupeds are now entering, and already species have passed beyond recall as a result of this method of treatment. During a period of scarcity of corn, wheat or potatoes we do not legislate for a "close season" or to limit the quantity to be taken in a day, or to prescribe the methods of taking or marketing, but we use every intelligent device available for stimulating an increased production. Similarly, for example, a close season and a limit upon the day's catch did not prevent the commercial extirpation of the scallop (*Pecten*) in certain localities. The fundamental fact necessary for recognition was that here is a specialized animal which breeds but once in its life time, viz., when one year old; the only adequate remedy possible was to save the young under one year old, permit them to breed, and then in the following autumn and winter market the adults before the end of their natural life.

In the case of the lobster (*Homarus*) the reverse condition obtains. The lobster produces approximately 97 per cent. of the normal total number of eggs after it has reached the size of 12 inches and an age of five to eight years. These breeding lobsters are then beyond the danger from all enemies except man. To prevent an undue diminution of the productive capacity of the lobster as a race the adults which have reached the breeding age must be conserved by uniform laws, if we are to have an annual supply of young produced.

The public and the legislators in relation to the oyster problem have passed the purely biological stages where the methods of increased production were involved and the problem now is to secure legislation for permitting increased production by adequate and well known methods, and to reassure the public upon the sanitary problems involved in the production, distribution and marketing, in order that the market may readily absorb the increasing quantities which can be produced, and thus have the benefit of one of the most important sources of a cheap and valuable food, as yet relatively unexploited.

The crab, shrimp, spiny lobster, are already feeling the effects of over-exploitation, and of neglect to consider proper methods for increasing the required production. The dogfish, destroying more food fish than are marketed, is to-day putting an enormous burden upon the fisherman, and through these upon the fish-consuming public. The existing conditions are unappreciated because unseen. The ocean has not yet become apportioned for purposes of securing increased efficiency of food production. The first evident signs are the world-wide acknowledgment of the desirability of extending the national three-mile limit. It is a significant feature that while the reason given is the increased range of gun fire, the chief opponents are those who wish to carry on commercial fisheries as close as possible to the shores of other nations, or of states. The recent quahaug war in Nantucket Sound, though a minor incident, has its significance. An extensive bed of hard clams, locally called "quahaugs" (*Venus mercenaria*) was discovered just outside the three-mile limit off the mouth of Nantucket Harbor, Mass. The opportunity for "easy money" was quickly and widely apparent and steam dredges from other states speedily "spoiled the market" for the local Nantucket hand-takers. Much bitterness was developed among the fishermen, and on account of the undeveloped facilities for distribution the public failed to secure a just advantage. The future stocking of the surrounding shallows was postponed by destruction of this bed of old spawners, designated as "blunts" in the trade, which yield a low market price compared to the young or "little necks." This vast expense of sandy shallows outside the "three-mile limit" to the edge of the continental plateau is a submarine plain, richer even than the Mississippi Valley in potential capacity for producing human food, but is relatively small when compared with the population which even now depends upon it for its sea-food. With the same degree of support accorded to the Bureau of Fisheries as the agri-

cultural interests have accorded to their department, this territory can be made as productive as the best farming and grazing lands of the nation.

We are but pioneers in this field, and, like our forefathers, may never see the realization of our dreams, but just as they pictured in prophecy the boundless fields of wheat, corn and cotton, so we may picture the development of aquatic farming, where even now hand labor is being replaced by machinery, and by more efficient methods of distribution. The great problem is how best to replace destructive exploitation by constructive methods of increasing production through annual crops.

To this end instruction in economic biology is needed. The federal commissioner, Dr. Smith, has ably pointed out the need of such educational facilities, and until such development can be secured the necessary safeguards for time and capital invested in this work are lacking, and progress must be as of the halt and of the blind.

As a practical matter it is exceedingly difficult for either state or federal departments to draw from a reluctant committee on appropriations money to be used upon projects of which they have no first-hand information and which are exploited by relatively few people. In Massachusetts the problem has resolved itself to a dilemma, whether the fisheries and the shell fisheries shall be maintained from the public treasury and freely open to the public, or whether the fishing rights on the tidal flats shall be leased to individuals and the maintenance and enforcement of the law be provided from the money secured from the leases or licenses and the balance used for reducing the state tax, thus regarding the lands under water and the public fishing rights as a state asset for the benefit of all the people. Consideration of the first proposition clearly leads to the result that if the community plants and cares for the annual crops for the benefit of the fishermen, why should it not do the same for the farmer? And just as the communistic growing of corn and potatoes has proved an economic failure, so must appropriations of money by the town or county for planting clams to be turned into cash by a few people whose interests or necessities impel, be futile unless it is frankly regarded as eleemosynary. The history of nations and of the ages proves that for increased production individual initiative and responsibility is necessary, and the time is not far distant when we must revise our practises and our laws so that all the suitable land below high-water mark may be utilized. No longer will obtain the anomalous condition where, as in Maine, Massachusetts, Rhode Island and other states, oysters may be artificially propagated, but not all other varieties of food and bait mollusks. The several state governments and the federal Bureau of Fisheries are now taking up the plan advocated in 1892, which evoked little response in this country, but which was reprinted in English and German current publications, wherein the writer advocated these practises and pointed out the similarity between the possibilities of agriculture and aquiculture for increasing the yield of food per acre.

It is a deplorable characteristic of human psychology that it is relatively easy to interest people in what is readily seen. The propagation of aquatic forms must overcome the handicap of lack of popular knowledge of the processes involved. It is comparatively simple to secure money to raise black foxes, denatured skunks, or guinea-pigs; but it is still difficult to interest people in commercial utilization of waters for growing fish and shell fish. Our methods of disposal of sewage and waste have militated against this type of investment and development of potentialities. Those who have been accustomed to exploit free goods and still scent opportunities for personal gain at public cost, have learned methods of putting pressure upon public officials and there are relatively few state or federal departments which are not to some extent hampered by some degree of political, personal or local pressure. The situation in Massachusetts is peculiar in that the town is still a dominant community unit, and town and county politicians recognize the advantage of political manipulation of such public assets as

the fisheries, and are loath to promote any development which is likely to curtail their opportunities for personal influence. It is most encouraging to see evidence that the federal departments are each year becoming less dominated by personal and party politics, and that the officials are permitted to follow the facts wherever they may lead, and to apply the possible corrections. So long as this obtains it is the duty of every organization and right-minded individual to support the federal and state authorities in their attempts to administer these assets for the public good.

Many thinking persons view with alarm the increasing tendency to substitute bureaucracy for democracy and state or federal control or regulation made necessary by changing conditions. The danger lies not so much in the form as in the facts. If the bureaus cease to be the real representatives of the demos, and instead of representing the whole people on the firm basis of judicially ascertained facts, their opinions and acts are coerced and warped from the truth by either subjective or objective considerations, so that they no longer represent the federal democratic ideals, but merely localities and special interests, bending to political and transient expediencies, the danger is not only threatening but is already *here*. The remedy is plain. It is in the hands of the people and must be speedily applied.

G. W. FIELD

GRANTS FOR SCIENTIFIC RESEARCH

(*Continued from p. 57*)

CHIEFLY COLLEGIATE INSTITUTIONS

THE following schedule embodies information obtained regarding research funds held chiefly by universities and collegiate institutions. With some marked exceptions these funds are available for use only under the immediate direction of the institution possessing the fund and by those connected with it either as members of the staff of instruction or as holding a fellowship. Funds devoted to agriculture and the mechanic arts, as for example those created by the federal government, it has seemed best to reserve for separate treatment later and more fully than is possible at present. The same is true with regard to funds devoted to astronomical research. Also information has yet to be received regarding marine biological laboratories. Consideration of the appropriations made by Congress for the support of the "Scientific Bureaus" of the United States would seem to come more particularly within the scope of consideration of another sub-committee.

The data already published regarding research funds for scientific purposes which are of general availability throughout the country, and of medical research funds have been gathered from replies to a circular letter issued by the Subcommittee on Research Funds in the spring of 1915, which asked the question:

> Will you be so kind as to inform me whether the institution with which you are connected possesses any research fund and if so what is its amount and for what purposes and under what conditions is it available.

The letter referred to was sent to such institutions as seemed likely to possess funds of this character, the publications "Minerva" and "Who's Who in Science (International)" serving as guides. It was widely distributed among collegiate institutions. Upon the replies received from these last the statements here presented are based.

University of Michigan, Ann Arbor, Mich. Harry Burns Hutchins, President. Three research assistantships have been established to aid researches of designated professors.

University of California, Berkeley, Calif. Benjamin Ide Wheeler, President. Research in general maintained by appropriations from the university funds. There is a considerable endowment for graduate fellowships. Appropriations for scientific publications are made from general funds, in 1916–17, $30,000.

California Museum of Vertebrate Zoology. Supported by annual gift from Miss Annie M. Alexander, of $7,500.

Scripps Institution for Biological Research, located at La Jolla. Wm. E. Ritter, Scientific Director. Supported by annual gift of $10,500 from Miss Ellen B. Scripps for which an endowment is pledged, and annual appropriation of $12,500 from state.

Massachusetts Institute of Technology, Boston, Mass. Richard C. Maclaurin, President.