which lead up to susceptibility to a given disease, then we shall have gone a very long way toward pointing out to the practical man the methods by which he will be able to avoid bringing about those specific changes which end in disease. It is certainly entirely within the bounds of the possible to know definitely just what particular changes lead to disease, *i. e.*, tend to invite a given parasite, or a given degeneration, and, knowing these, to put the plant or animal under such conditions as to food, light, air, etc., as will lead to the development of counter changes tending to ward off disease. A beginning has already been made, but much remains to be done, and a more inviting field of research does not anywhere lie open to the young and earnest experimenter.

The so-called 'practical man' has gone about as far as he can go and must have help from the technical and laboratory man. Personally, the speaker has no sympathy with that line of thinking that would hold the pathologist to the narrowest kind of experimental or field work, or which requires him to make bricks without straw. Of course, I mean bulletins without new discoveries to put in them. Nothing is gained by repeated threshing of old straw, and time, the most precious of all things, is lost. Haphazard experimenting is not science. Every decade will not be fortunate enough to stumble on a Bordeaux mixture. The trained pathologist should be given plenty of time and the largest liberty, and allowed to work out his own salvation as best he can. This he must do very largely by experimental devices, and he certainly will never be able to get very far without a thorough technical training and use of the exact methods of the laboratory, or, as I have already pointed out, without chemical knowledge and much assistance from the chemist and physicist. I would not disparage field work. It is right as far as it goes, and I think every pathologist ought to have a thorough acquaintance with diseases as they occur in the field; but a man may work all his life in the field and never get beyond a rule of thumb, if he does not also have that technical training which is usually acquired only in the laboratory. The pathologist must be able to see all that the practical man sees, and a great deal more. In other words he must not only see that things go on in a certain way in the field, but he must also be able to probe beneath the surface and determine why. It is then, often, not difficult for him to make nature conform to some other and better plan whereby harvests are saved and the hungry are fed.

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*THE BIOLOGICAL BASIS OF LEGISLATION GOVERNING THE LOBSTER INDUSTRY.**

CAUSES OF THE DECLINE.

The causes of the growing scarcity and the yearly diminishing average size of the lobsters caught are: (1) *The natural demand,* arising from an increasing population. This increased demand has not been met by a correspondingly increased source of supply. (2) *The existing laws,* for the reason that the destruction of adults has been permitted. The present laws, with their practical difficulties of enforcement, have had an adequate trial. The decline of the lobster industry demonstrates that these laws have proved inefficient for increasing or even for maintaining the supply. The chief defect of the present laws seems to lie in permitting the destruction of adults.

SUGGESTIONS FOR REMEDIAL LEGISLATION.

Of the suggestions for legislation to check this decline, seven, either singly or in

* Abstract of a 'Report' to the Massachusetts Commissioners of Fisheries and Game, and published in their 'Annual Report' for 1901 (Public Document No. 25).

combination, appear to be especially prominent:—

1. A close season (*a*) for a portion of each year, or (*b*) for a term of years.

2. The continuance of the present 10½-inch law, under more effective enforcement.

3. The substitution of a 9-inch law.

4. The prohibition of the killing of egg-bearing lobsters.

5. The prohibition of the killing of any female lobsters.

6. The removal of all restrictions as to catching.

And finally, as an entirely new proposition, which I personally venture to advance,

7. The protection of all adult lobsters above the breeding age, and the removal of restrictions on the catching of the immature which are of satisfactory marketable size.

A just and adequate law which meets most requirements, wherever identical conditions obtain, will increase the chances of securing effective uniform legislation throughout the lobster-producing districts.

An impartial balancing of the merits and defects of the several propositions is here attempted:

1. *A Close Season.*—(*a*) For a portion of the year. A close season may bring manifest and satisfactory results in cases where the animal is a rapid breeder, or where the young reach maturity in a short time. But a close season is not equally applicable for checking the numerical decline of every, or any particular, animal. This is notably true of the lobster. A close season must fail to bring the expected results, for the reason that the lobster is a slow breeder, laying eggs but once in two years, and carrying these eggs, attached to the modified legs under the abdomen, for ten or eleven months after laying; while the young require probably from four to seven years to reach maturity and attain a length of seven to ten inches.

Finally, the fundamental defect of a close-season law is that it restricts the demand but does not adequately and economically increase the supply.

Aside from the practical difficulties of securing a uniform close season throughout the lobster range, and enforcing the laws, the value of the close season to the lobster as a race is commensurate with the duration of this close season. The longer it extends, the better for the lobster but the worse for man. The burden upon investments in the lobster fisheries is increased. The absence of the lobster from the human food supply is felt by the public. Yet all this is of little avail, for the effects of the close season are not permanent. The causes of the decline have not been removed. The lobsters, through a close season, either from one to six months each year, may have a chance to 'catch up,' only to be themselves 'caught up' with redoubled energy, resulting in a glutted market, and consequent economic waste for a time, with the certainty of a rapid return to the former conditions which made a close season necessary.

(*b*) Close season for a term of years. Most of the foregoing statements apply also to a close season for a term of years. The primary inherent defects in the close season are that it does not reach the cause of the decline, and it fails to recognize the fact that the lobster can and should be reckoned as a perennial and perpetual food for man. Human effort can so control conditions that the supply may be large or small. By taking proper measures the lobster supply can be made abundant and continuous, instead of intermittent.

2 and 3. *Continuance of Present Length Law or Substitution of Another.*—The 9-

and 10½-inch laws are the ones which have met widest favor. They are identical in inconvenience of application and in difficulty of enforcement.

Neither the 9-inch law in New York, the 9-inch and 'female lobster with spawn attached' in Connecticut, 9-inch and a closed season in Rhode Island, 10½-inch in Massachusetts, 10½-inch and 'female lobsters while carrying their spawn or hatching their young' in New Hampshire, 10½-inch since 1897 in Maine, nor the 10½-inch and a closed season from June 30 to January 14 in the Maritime Provinces, has prevented the continued rapid decline in (1) the number of lobsters caught, (2) the average size of the lobsters caught, (3) the average number of egg-bearing females reported, (4) the number of persons who can depend upon the fisheries for support, or (5) has checked the rapid rise in the price of lobster meat.

Further, these laws have been found by experience to be difficult of application and expensive in enforcement and alike disagreeable to officer and offender.

The sole apparent merit of this law seems to be that it does prevent the catching of some lobsters; just how many is dependent upon the honor of the fishermen and the means of enforcing the law. Its greatest defect, and from a scientific point of view an irreparable one, consists in the fact that it affords no protection to those lobsters which most need protection—the mature breeding individuals—but puts a premium on their capture through tacitly specifying that only adults above the breeding age shall be killed. What would be the effect upon our supply of poultry and eggs if a law should be made 'protecting' poultry under one year, or under a certain size or weight? It absolutely ignores the biological laws which man has found by experience to be of the utmost importance wherever it has become necessary to increase the natural food supply to meet the increasing population—the protection of the adult animal in order to secure a supply of young of that species.

4. *The Prohibition of the Killing of Egg-bearing Lobsters.*—To prohibit the killing of any egg-bearing lobsters is good legislation so far as it goes, but it is open to the objection that it pushes into prominence the temptation to comb off the eggs, and thus make the lobster a marketable one. It has practical difficulties of enforcement.

5. *The Prohibition of the Killing of any Female Lobsters.*—The prohibition of the killing of any female lobster would promise more effectiveness were it not for the fact that it involves catching, and a subsequent sorting and liberation.

6. *The Removal of all Restrictions as to Catching.*—The proposal to remove all restrictions as to catching lobsters must inevitably lead to the destruction of the industry, unless a sufficient artificial supply can be maintained to meet the demand, and thus far this seems impracticable. Certainly satisfactory results have not been reached in the case of the lobster, though further investigation and examination must yield far-reaching results.

7. *The Protection of All Adult Lobsters Above the Breeding Age, etc.*—The method of protecting all the adults, and catching only a portion of the young, promises very satisfactory results in the case of the lobster, for the reasons:

1. That the ratio of the biological, *i. e.*, reproductive, value increases very rapidly after the size of nine to ten inches has been reached, as shown by Professor Herrick's table.

2. The number of enemies diminishes very rapidly as the lobster increases in size.

SUGGESTIONS FOR NEW LEGISLATION.

The logical basis, then, for the law is:

1. Protect the adults. Catch only the small lobsters, not the large ones.

2. Protect enough of the young to ensure a sufficient number of adults.

3. Protect those below a size which experience has shown to be adapted for economic use, say six inches.

4. Use only a legal standard pot, having the opening of such size as to prevent the entrance of a lobster say above nine or ten inches, and with slats far enough apart and numerous enough to insure the escape of all lobsters less than six inches. Fix a date when all pots shall conform to the standard.

5. Penalize the possession or sale of lobsters above ten inches and below six inches, and of pots not conforming to the legal standard.

6. Establish a State committee, to cooperate with similar committees from the other lobster-producing States and the British maritime provinces, for considering the advantages and possibilities of uniform lobster laws, for coordinated investigations of the important economic facts in the natural history of the lobster, and for devising improved methods of artificial lobster culture. Rhode Island is obtaining very valuable and practical results on some important phases of the question under the direction of Professor Mead.

The chief apparent objections are:

1. That such a proposal as has been outlined is too radical, too great a departure from precedents and from the laws in force in other States. To this it may be answered that the existing lobster laws have little common-sense foundation; they have been based upon misconceptions, and often, no doubt, upon ignorance and local politics; they are directly contrary to scientific experience, and the continued decline of the lobster industry has proved them to be ineffective for the purposes for which they were instituted. They are based neither upon the laws of human economy nor upon the natural history of the lobster.

2. It has been claimed that 'such laws as those proposed would lead to the capture of all the lobsters.' At first an actually greater number of lobsters would undoubtedly come into the market; but the increased number of individuals killed would not result in such an increased weight as to materially affect market conditions, and the productive capacity of the protected individuals would be expected to more than offset the apparent loss from the marketing of immature individuals. In other words, the actual value of one above ten inches long in potential productive capacity is many times that of one between six and ten inches long, and man could use as food a larger number of six-inch lobsters without doing the biological damage which results from the killing of a single lobster of from nine to eleven inches long, and at the same time have an actually greater weight of lobster meat. If it is feared that under this proposal the lobster does not get sufficient protection, make the limit still narrower, say from between eight or nine inches to six inches.

1. Such a law would be relatively easy of enforcement, through the inspection of lobster pots.

2. It would work a minimum injury to vested interests, since sufficient time can be given to make all pots conform to the standard.

3. It does not remove the lobster from the market, and so does not interfere with the immediate or future interests of fishermen, dealers and consumers.

4. By protecting those lobsters which are of greatest biological value the interference

with the natural laws of increase is minimized.

5. It furnishes a basis for uniform legislation throughout the lobster-producing section. Being based upon common sense, and in close conformity with the natural history of the lobster and with human scientific experience with food supplies, it commends itself to fishermen and others who know human nature and the lobster in a practical way.

Finally, the proposed law, while fundamentally scientific, is eventually a compromise measure and combines the advantages (1) of a close season throughout the year for a part of the lobsters (*i. e.*, for those productive adults above a size to be agreed upon), and (2) of the size limit, thus meeting the wishes of the believers in both the 10½- and 9-inch laws. It seems to promise effectiveness in meeting existing conditions and in checking the decline. It is adapted for ready enforcement without resort to methods distasteful to officers and people, and at a minimum expense to the state.

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The following have completed their membership in the American Association for the Advancement of Science since December 1, 1901.

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