magnitude or in kind, and in such cases, when previous experience fails, they are thrown back on experiments and theoretical analysis, where a thorough knowledge of theoretical mechanics is indispensable.

A reform in the engineering schools as here suggested will undoubtedly meet with many obstacles. Administrative arrangements may be somewhat dislocated, text-books may have to be revised, new teachers may have to be engaged and instruction may suffer somewhat in the period of transition, but the course in theoretical mechanics may not need to be longer or more difficult than at present. What is proposed is chiefly a rearrangement of courses, with an addition of such matter as will make the resulting courses, each of them, more self-contained and complete. By avoiding repetitions time will be saved, and by a more complete and logical presentation of the subject, including a full explanation of fundamental concepts, it is believed that it will be easier for the students to grasp. The reform may perhaps be best carried out by an evolutionary process beginning with the establishment of a small department in theoretical mechanics. This department might gradually take over the scattered courses now given under various departments and strengthen them by a process of unification and completion. Thus the department would gradually grow in magnitude and importance. This method may be preferred in particular where the services of a teacher eminent in this science are available, to whom the task of building up the new department can be entrusted.

When fully developed, such a department should have charge of the entire range of subjects specified under sections (1) to (4) above, but besides the classical mechanics it might also properly include wave mechanics and mechanics of relativity. It should work in close cooperation with the department of mathematics on one side and with the various professional courses including physics on the other side.

With the adoption of such a program in the American technical colleges, it should be possible not only to equal but to surpass the achievements of corresponding European institutions.

PLANT QUARANTINE

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THE idea of quarantine[1] had its inception in connection with the attempts on the part of early Europeans to exclude and prevent the spread of dreaded plague or black death. Venice inaugurated such a restrictive measure as early as 1348, which was followed by other European countries. In spite of the long experience of human health quarantine, England did not establish her first health quarantine until 1710, and delayed in passing the Public Health Act until 1896. Thus we see that many years have been required to perfect the present highly efficient and valuable public health measures now maintained by all the progressive nations of the world, and accepted by all their citizens. It is my firm belief that plant quarantine will, in a much shorter space of time, attain a similar place in the affairs of civilized peoples. Fundamentally it is as sound to protect the plant life of a country from the constant encroachments of insect depredators and plant diseases as it is to protect human health. An abundant and available food supply is as essential to human beings as is health and almost as personal, because it affects the livelihood of every individual, since the prices and availability of food are largely regulated by supply.

In view of the fact that there is so much general misunderstanding regarding plant quarantine, this article is written with the aim of presenting the claims of this young member of the administrative family.

In the first place, quarantine is a police power. This makes it very objectionable to certain minds. Anything that questions the free rights of individuals to act as they please is ever open to criticism. Law enforcement is always a difficult task, and even the most thoroughly qualified, tactful and resourceful official has great difficulty in handling the public as agreeably as is expected. Nearly all the complaints that arise from quarantine originate in regulatory and law-enforcement proceedings. This fact must be recognized at the outset. In this respect quarantine is no different from other measures enforced by due processes of law.

Plant quarantine, like health quarantine, was born of necessity—it was not the child of speculative philosophy, nor was it an ethical experiment. The early introduction into this country of such serious pests as the codling moth, San José scale, citrus scale insects, cotton boll weevil, pear psylla, cabbage worm, gipsy and brown-tail moths and many stored-product

[1] The term *quarantine*, literally meaning a period of forty days, was originally designated as the time during which a ship, suspected of being infected with a serious contagious disease, was obliged to refrain from all intercourse with the shore. It has always come under the powers of the police.

and household pests, as well as the rapid dissemination over the land of such native insects as the bean-weevil, chinch bug, Colorado potato beetle, and other pests, were at first looked upon as a matter of course. But when it was learned that our system of agriculture, embodying the production of large areas of single crops, afforded unusually favorable conditions for these pests to propagate and do unheard-of damage, a new idea of insect immigration and migration was conceived on the proposition that exclusion is easier than extermination and cheaper than control!

With this idea in mind, the first state plant quarantine laws were promulgated and put into execution. The problem appeared easy at first, when there was but little knowledge of world economic entomology, when insect pests were supposed to be largely carried on nursery stock and when domestic and international commerce was slow and concentrated at the larger inland cities and at a comparatively few seaports. As a matter of fact, it was not difficult to enforce the laws as conditions existed then. But commerce developed faster than plant quarantine, which is well illustrated by the fact that a national conception of plant protection did not crystallize until 1912 with the passage of the first National Horticultural Law. This tardiness of action on the part of the government permitted the free entrance into most parts of the country of many insects which seriously tax the agricultural welfare of the nation.

To prevent a continuance of this unwarranted spread of pests, plant quarantine has been thoroughly overhauled and strengthened. A number of important steps were recognized and taken. It was clear that to be effective such legislation should at least provide:

1. For the absolute exclusion of certain serious pests and all articles of commerce likely to carry them from known areas of infestation. This is virtually an embargo.
2. The right to destroy, reject or exclude materials when inspections reveal the presence of insect pests or plant diseases.
3. The right to prescribe restrictions and regulations under which plant materials may be admitted into a region.
4. The power to formulate plans and enforce regulations to confine an insect to a given area and to resist its spread from one district to another.
5. The authority, power and financial means necessary to discover and to exterminate, if possible, a pest newly established in an area.

This is a difficult and complex program which requires expert training, skill and experience. Insects and diseases are carried in many ways. When all these are learned some of the complexities will be removed. Years of careful study will be required to solve many of the problems of pest introduction and to perfect ways and means adequate to meet them.

It is impossible to predict what an insect will do in a new environment. A great many of our worst pests were either unknown or of no economic importance in their native homes. Therefore plant quarantine can never be safely administered as a compromise measure.

In considering the above five points it would appear that complete exclusion is the most important, and at the same time most difficult to enforce. Such exclusive quarantines have been maintained against all products likely to carry pests from various districts throughout the world known to be infested with fruit flies, citrus canker, and the foot and mouth disease of live stock. Plant pests and diseases, as well as human diseases, such as plague, typhus and dysentery, do slip through such quarantine lines, but these failures are shallow arguments that such preventive measures are valueless and should be abandoned. As a result of such regulations the public becomes aware of the danger and the majority of those engaged in commerce or travel will cooperate to enforce the law, thus materially reducing the hazards of unknowingly bringing dangerous pests and diseases into the state or nation. Many of them will also actually assist in law enforcement. In this manner an insect pest may be kept out indefinitely or its entrance greatly delayed. Such delays enable the entomologists to study the insect and devise methods of control. There is every reason to believe that plant quarantine enforcement, together with wide and continued publicity in the form of suitable literature placed in the hands of travelers, have been responsible for the fact that the Mediterranean fruit fly has not already been introduced in sufficient numbers into California from Hawaii to have become established here. The exclusion of the Mexican orange maggot and the cotton boll weevil are other instances which might be cited in this connection. If the insect finally slips through some leak it is more likely to be apprehended than in the days before quarantines were known, and the chances of exterminating it before it becomes widely distributed are very favorable—laws, trained men, improved methods of control, equipment, like a well-trained and equipped army, are immediately available. In the case of health quarantine, plague occasionally enters our seaports in spite of the eternal vigilance of health authorities. Following this introduction an extermination campaign, at whatever cost, eventually conquers it, and no one questions the expense. And now and then a disease, like influenza, slips through the ports and sweeps over the whole country. Does any one wish to abolish health quarantine because of such lapses?

In the early history of plant quarantine, inspection was the sole basis of admission or rejection of plant materials and is still an important part of present-day procedure, particularly in dealing with intersectional, intercounty, and interstate movements of agricultural products. Inspection can never be 100 per cent. efficient because of the human limitations of the men doing the work. Yet it is the only means whereby produce can be moved with a degree of safety without paralyzing commerce. That very many serious pests are intercepted in this way is another indication that quarantine measures reduce the number of foci of infestation and thus delay a rapid spread over the entire country. Inspectors become more proficient and experienced from year to year, and it is to be expected that the service will thus be gradually improved.

The right to prescribe restrictions and regulations governing the admission of certain products results in no great inconvenience to the shipper and sets up safeguards for the protection of large districts against certain serious pests. Such safeguards in the form of restrictions and regulations are usually agreed upon before legal steps are taken, and all the cases I know of are carried out harmoniously and greatly to the benefit of all concerned. They furnish real financial incentives for those in infested areas to reduce the offending pests to the lowest possible minimum in order to secure more favorable regulations, or, as in some cases, to cause them to be entirely withdrawn.

Circumscribing certain areas within a given part of the country which may be infested with a serious pest or disease is an important prerogative of quarantine. This method is commonly employed and is at the present time in force against the gipsy and brown-tail moths, Japanese beetle, European corn borer, date palm scales, Mediterranean fruit fly, citrus canker and similar insects and plant diseases. The idea is to prevent the artificial spread of such pests throughout the country by defining boundaries across which articles of commerce most likely to carry the pest can not proceed. In the meantime everything is done through the employment of artificial and biological methods of control to reduce the infestation and thereby reduce the natural spread, which can not be stopped by legal processes of law. In this manner it is much more difficult for any of these pests to jump across the continent with plant products or other materials sent by mail, express or freight, or carried in private automobiles. As illustrations we might cite the cases of the gipsy and brown-tail moths, the Japanese beetle and the alfalfa weevil. All are gradually and slowly enlarging their boundaries, but none of them have been able to make long-range establishments throughout the country. During the period of restriction all the more important facts concerning the life habits and control of all these pests have been ascertained and distributed throughout the country for the free use of all the people in meeting any like emergencies elsewhere. In these modern times the chances of distributing pests by means of automobiles and even aeroplanes offer probably the greatest hazards now faced by quarantine officials and thoroughly justify the entirely inadequate inspection stations found at some state and national boundary lines. When the private individual is aware of the importance of this service, the necessity for it will be greatly reduced and the inconvenience caused accepted without undue criticism.

The extermination of a serious pest, once thoroughly and permanently established in a new district, is a question of very great importance, not only to the industries involved at the present time, but also to untold generations to come. It has often been argued that when once thoroughly established an insect pest can not be eradicated. This fallacious statement has been based upon a few half-hearted and inadequately and tardily financed attempts which were doomed to failure at the beginning. Eradication is possible if we as a county, state or nation are willing to pay the price. In this connection it might be well to call attention to the fact that quarantine officials in California have already discovered initial infestations of several newly introduced pests, including the pecan leaf case bearer, the rough strawberry weevil and the citrus white fly, and have apparently successfully eradicated them at a cost so surprisingly low as to call forth no criticisms whatsoever. It now looks as though the campaign against citrus canker is also a case in point. The present campaign against the newly established Mediterranean fruit fly in Florida promises to furnish a glorious example of man's ability actually to exterminate a serious insect pest established over a large territory. Only the obstructionists can prevent its final consummation.

Imagine if you can an area comprising some 1,500,000 acres of fruit trees stretching across nine states with a total valuation of approximately $1,800,000,000 and an annual crop worth $240,000,000. This is the area and investment that is subject to possible injury and financial embarrassment by the Mediterranean fruit fly. No one will deny the right of the owners of these orchards to demand protection from the invasion of any insect pest which will add to the great expense already necessary to produce, harvest and market such a valuable crop. The comparatively small sum of $4,250,000 was appropriated to safeguard this great industry, which in reality

belongs to the nation as a whole. It has been spent as wisely as possible in an intensely important and feverish campaign conducted in a few months. The situation has been under orderly and complete control throughout the undertaking. The job has not been completed. No one acquainted with the problem expected it to be finished short of at least two cropping seasons. More money is needed to finish the task. Instead of an adequate appropriation to continue this work, $1,000,000 only has been made available. If this amount is not sufficient then other funds must be obtained, because this is one case where the actual financial considerations involved thoroughly justify the expenditure of large sums. This is a national problem and should be met as such. To embarrass financially or to ruin the fruit growers of Florida to accomplish the end in view not only is unjust, but might also result in the defeat of the project. Without the whole-hearted and sympathetic cooperation of these orchardists we can not hope to destroy the very last fly.

Plant quarantine truly seeks to protect the agricultural resources for all the people. I refer to agriculture because the farmers more than any other class of people have been imposed upon by these foreign insect foes. They have been compelled to suffer great financial losses and to fight a continual and expensive campaign against insect pests and plant diseases. There is no discrimination on the part of the pest; every crop in every section of the continent is subject to their unrelenting attacks which result in absolute waste and therefore loss to the well-being of the entire country.

Is it any wonder then that the farmers have been positive in their demands for protection against additional hordes of insect pests? And even though many of the latter have already invaded the fields and orchards, are we not justified in our requests to close up the leaks and keep the others out? Plant quarantine can do this with proper legislation, judicious law enforcement, adequate financial support and the sympathetic cooperation of a well-informed public. It can never be absolute, but it can be made to meet the agricultural needs of this country through capable and determined supervision.

Are we as a people to stand aside and watch the continued procession of destructive pests file into our country, sweep over our fields, orchards and forests, destroy our live stock and invade our very homes on the shallow assumption that we are helpless because of certain uncontrollable biological factors? Or shall we challenge their right to such free aggressions by the enactment and enforcement of adequate plant quarantine measures?

OBITUARY

RECENT DEATHS

DR. J. R. GUTHRIE, dean emeritus of the medical school of the University of Iowa, died on March 14, at the age of seventy-two years.

HENRY R. HOWLAND, formerly president of the American Association of Museums and for sixty years member of the board of managers of the Buffalo Society of Natural Sciences, died at Buffalo on February 4, at the age of eighty-five years.

DANA JACKSON LEFFINGWELL, for the past three and one half years assistant professor of zoology and curator of the Charles R. Conner Museum of the State College of Washington, died on March 7 at the age of twenty-nine years. A correspondent writes: "Dr. Leffingwell was educated at Cornell University, from which institution he received the doctorate in philosophy in 1926. His greatest interest was in the field of ornithology, particularly the study of game birds, although this interest was extended to all branches of natural history. He was a keen student of wild life and of conservation. For the past three summers he had been employed by the New York State Conservation Commission engaged in making a survey of the food resources of the streams of the state."

PROFESSOR AUGUSTINE HENRY, forestry expert and botanist, died in Dublin on March 23, at the age of seventy-two years. He had been professor of forestry in University College, Dublin, since 1926. During eighteen years' residence in China, as an official of the Chinese Imperial Maritime Customs, he became interested in botany, later becoming an authority in this field.

DR. KENNEDY JOSEPH PREVITÉ ORTON, F.R.S., professor of chemistry in the University College of North Wales, died on March 16, in his fifty-eighth year.

PROFESSOR GIOVANNI MINGAZZINI, director of the psychiatric clinic of the University of Rome, died suddenly at the age of seventy years. He was the author of numerous publications on anatomical and physiological subjects and on the pathology of the nervous system.

MEMORIALS

A MEMORIAL meeting in honor of the late Dr. Richard Mills Pearce, Jr., will be held on April 15 at 4 P. M. at the Rockefeller Institute for Medical Re-