deposited in the tissues of the plant where they hatch out and the larvae invade fresh tissues. The larvae are found not only in the roots but also in enormous numbers throughout the diseased tissues. While the habits of these species outside the host plant have not been thoroughly studied, it seems reasonable to suppose that on the falling of diseased leaves or trunks the nematodes would ultimately find their way to the surface of the soil and the subjacent layers and that infection of the young plants might take place by the migration of the nematodes from the soil to the new plant. It has been shown that the nematodes will live in the soil about an infected palm. Very recently Zetek has made observations which have led him to suggest that the termite, *Coptotermes niger* (Snyder), may be a mechanical carrier of this nematode from the old host to the new plant, he having demonstrated nematodes clinging to the bodies of the termites which were living in a cocoanut palm infected with "red ring."

The writer has been able to study the disease in Panama and particularly in Spanish Honduras. While it would appear that the nematodes in question are certainly concerned in the production of the disease, the lesions produced in the palm consisting of the softening of the tissues, their liquefaction and subsequent necrosis, are not such as are usually attributed to nematodes. Both with the idea of acquiring information regarding the presence of some additional pathogenic agent in the disease and also of ascertaining any pathogenic action of the nematodes not only for the plant, but for animals, inoculations of suspensions of the nematodes in saline solution into mice, guinea pigs and rabbits were undertaken. The guinea pigs were inoculated intraperitoneally, subcutaneously or intraintestinally. The mice were inoculated subcutaneously and the rabbits intravenously or subcutaneously. When the injections were made intraperitoneally into guinea pigs the death of the animals often occurred in which there was a general peritonitis associated with a short bacillus, but no nematodes were found in the peritoneal fluid, the blood or other organs of the animal. In fact, after intraperitoneal inoculation the nematodes were never found alive in drops of fluid withdrawn by a capillary pipette from the abdominal cavity longer than two and one half hours after the time of the inoculation. In the guinea pigs which were inoculated by injecting the fluid containing the nematodes through the peritoneal cavity and walls of the intestines directly into the lumen, the nematodes were not subsequently found in the feces of the animal. Some of the rabbits which were inoculated intravenously also died, in which bacilli were isolated from the blood and liver, but no nematodes were found in these situations. In none of the experiments was any pathogenicity of the nematodes for these laboratory animals demonstrated. Cultures were made from the lesions of "red ring" after burning the surface of the palms and in practically all instances species of fungi or bacilli were cultivated. Much more extended observations must be made before we can conclude that the lesions of "red ring" are produced solely by *Aphelenchus*. Perhaps *Aphelenchus* may also carry mechanically bacteria with it into the tissues of the plant or offer a more favorable portal of entry for other microorganisms. Obviously, termites do not serve as the infective agent in many cases because in many cocoanut palms infected with "red ring" no infestation with termites is present. Therefore, in the case of *Aphelenchus*, so far as our knowledge goes, parasitism has apparently developed for plant rather than for animal life.

In conclusion it is obvious that I have but touched the fringe of this vast subject. However, it is my hope that this brief summary of some of the problems that have been elucidated and of some of those that still await solution may stimulate further research.

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UTILIZATION AND CONSERVATION OF THE TIMBER SUPPLY[1]

IN spite of the confusion of tongues and the tangle of comment, criticism and innuendo which always arise when attempts are made to fix the blame for the destruction of the country's timber supply, the principle that intelligent use of wood is one of the most effective forms of forest conservation has been gradually gaining the recognition it deserves. Acceptance of this principle implies belief in another, *viz.*, that the lumberman, the manufacturer, the retailer and the consumer are corporately responsible for securing from each piece of wood removed from the forest the greatest practicable quantity of service. The economics of good utilization are, however, but vaguely understood even by students of the subject; and the bearing of utilization on conservation is not appreciated at all by the millions most directly concerned.

One who investigates the pathological problems of wood conservation soon comes to realize that there is no such thing as a *normal* life of wood. He finds that fire and flood, wear and tear and breakage, neglect and plain carelessness are destroying an immense amount of wood every day in the year; he finds

[1] From the Office of Investigations in Forest Pathology, Bureau of Plant Industry in cooperation with the Forest Products Laboratory, United States Forest Service, Madison, Wisconsin.

insects and their relatives inflicting their evil share of damage; but he will be forced at last to the conclusion that the most important agents of wood destruction, either direct or indirect, are fungi. Fungous decay has reduced millions of cubic feet of our standing timber to rotten wood. In rough or finished material such as pulpwood, ties, poles or lumber the wood is subject to attack by fungi from the moment it is cut from the tree, and sooner or later practically all forest products which are not broken up or burned end their usefulness as a result of decay.

The loss which the country suffers annually from such decay can not be determined accurately, but one may estimate it roughly by combining data from various sources. In some cases the loss is directly indicated by the extension of service utility which results from preservative treatment. In other cases estimates are guesses, although they may be based on all the data available and adjusted as a result of personal observation.

In the accompanying table the figures showing loss from decay divide themselves into two groups. The first five types of material are necessarily destroyed in manufacturing processes for the sake of their derivatives—heat, wood pulp, wood distillates, tanning extract and excelsior. Loss in this group may be measured as a reduction in quantity or quality *of the derivatives.* In the rest of the classes the loss figures represent the amount of the annual cut needed to *replace* wood which has become unserviceable throughout the country on account of decay. The figures are believed to be conservative.

The loss figures mean, for instance, that one half the annual demand for poles results from the necessity of replacing rotten ones in the pole systems all over the country. The possible savings listed are estimates of the number of cubic feet which might be saved by proper handling and storage of material and by preservative treatment. Such measures would conceivably reduce the annual demand for poles by an amount equivalent to approximately fifteen and a half million cubic feet.

To the consumer, decay in forest products means more than the loss of the actual wood which has become rotten. It means replacement costs for lumber and labor, idle factory space and abortive attempts to use substitute materials in places where nothing can ever have the utility of wood. The individual purchaser bears most of the expense.

From the national viewpoint the cost of decay in forest products is the reduction of forest resources. The total annual growth of new wood which takes place on all the producing forests of the country is estimated at approximately 6,000,000,000 cubic feet. The loss figure at the bottom of column 3 in the table is nearly two thirds of this amount. The figure at the bottom of column 5, representing *preventable* decay, is approximately 30 per cent. of the total annual growth figure; and, for the present, at least, the difference between the totals of columns 3 and 5 must be considered unavoidable loss.

Our timber supply is like a reservoir which is fed by a small stream with an annual flow of six units. The outlet of the reservoir is discharging nearly

ESTIMATED ANNUAL LOSS RESULTING FROM DECAY IN FOREST PRODUCTS AND ESTIMATED POSSIBLE SAVING

Estimated quantity of timber removed from forests of the United States		Estimated annual loss from decay		Estimated annual possible saving (Preventable decay)	
Kind of Material	Equivalent in Standing Timber Cubic Feet	Equivalent in Standing Timber Cubic Feet	Approximate per cent.	Equivalent in Standing Timber Cubic Feet	Approximate per cent.
Fuel wood	9,500,000,000	712,500,000	7.5	237,500,000	2.5
Pulpwood	585,000,000	58,500,000	10.0	29,250,000	5.0
Distillation wood	133,000,000	9,975,000	7.5	6,650,000	5.0
Tanning extract wood	95,000,000	—	—	—	—
Excelsior wood	23,400,000	1,170,000	5.0	585,000	2.5
Lumber and dimension material	7,776,300,000	1,166,446,000	15.0	777,630,000	10.0
Ties, sawed and hewed	1,320,000,000	660,000,000	50.0	330,000,000	25.0
Fence posts	1,800,000,000	900,000,000	50.0	225,000,000	12.5
Mine timbers	395,550,000	79,110,000	20.0	59,333,000	15.0
Poles	55,250,000	27,625,000	50.0	15,470,000	28.0
Piling	39,000,000	9,750,000	25.0	4,875,000	12.5
Vehicle stock furniture, woodenware, handles, etc.	45,800,000	4,580,000	10.0	2,290,000	5.0
Cooperage	314,820,000	31,482,000	10.0	15,741,000	5.0
Shingles	198,000,000	29,700,000	15.0	19,800,000	10.0
Veneer logs	105,980,000	5,299,000	5.0	2,650,000	2.5
Export logs and hewed timber	18,400,000	—	—	—	—
Total	22,405,500,000	3,696,137,000	16.5	1,726,774,000	7.7

twenty-two and a half units a year. From the outlet stream certain rivulets are taking away four units, and of these more than one and seven tenths units are escaping through leaks which can and should be stopped up. Naturally the level of the reservoir is sinking. A series of new feeding streams (reforestation) will bring in additional units, slowly at first, and later more rapidly, and construction of the channels should be commenced at once. Meanwhile, however, the most effective means of slowing down the drain on the reservoir is to stop the leaks. In other words, stopping the leaks in utilization—cutting off the drain due to preventable decay—is one of the most effective single means of forest conservation. On the basis of the figures indicated, the stoppage if completely successful would amount to the same thing as increasing our producing forest area by 30 per cent.

The possible savings shown in the table can not, of course, be realized all at once. Effective changes in storage and handling methods are at best brought about slowly, for in many cases utilization depends on custom rather than scientific fact. Research has developed comparatively easy and extremely effective methods for preserving wood. Large organizations such as railroads and telephone or electric light companies can take advantage of the situation either by building wood-treating plants of their own or by arranging to have their ties or poles treated at commercial plants; but the individual householder has great difficulty—if indeed he succeeds at all—in securing enough treated lumber for his front porch. A certain amount of economic adjustment is necessary. It will surely come with a clearer understanding of the relation between proper use of timber and conservation of the forest.

REGINALD H. COLLEY

THE ROMANTIC AND IDEALISTIC APPEAL OF PHYSICS

THE bare facts, the ordinary sensations and common experiences in the daily life of the average physicist to-day, be he teacher or research worker, can certainly not be made to form an appeal to any man. Financially his lot is not a wealthy one nor socially is it high. This is just as true to-day as it was in the days of the dependent philosopher slaves of Greece or the roaming impecunious scholars of the Medieval and Dark ages. Yet even now in this modern age, where in America at least education is somewhat free from the influence, benevolent or otherwise, of wealth, church or patronage, we still find recruits in physics coming up to take the place of each one who is called away to higher realms of truth by death.

How can it be that the plain facts of life do not dismay the recently initiated, discourage discipleship and eventually cause the extinction of this element of our social system, the class of physics teachers and research physicists?

What can it be that as the world goes on and on its yearly passage of 400 millions of miles onward through space keeps and augments the faithful band of physicists?

Surely it must be some powerful force, soul gripping, that insensibly winds its tentacles around each likely nature-loving heart, never to release till death ends the all-absorbing efforts of that seeker after truth.

Solving the riddles of the universe, in a large way or a small, whatever might be his fortune, develops and comes to be the deep passion of the initiate into this profession. Close to nature and by it closer and closer every day to the Almighty God who made him, what matters it to the physicist if the days be dull or neighboring man uncouth? His soul is more or less aloof from mortal strife. The pangs, the torments, the hurts of common life lack their sting except insofar as they keep him from his teaching, his studies, his research.

The recompense of the physicist is not a worldly one at all. Therein lies reason for the eternal and the intangible nature of the appeal to him.

He realizes his reward with mental satisfaction as he feels his intellectual power over problems of nature. He keenly appreciates his mental growth and longs to tackle deeper and deeper problems of his existence and his world.

Though a sincere disciple of truth, he knows not how to express in words to others the strange influence that henceforth for him controls his destiny. And yet those of his students and his assistants most promising as future workers in this field of natural science feel the appeal through him. They can not help but follow eventually. No artificial call for recruits can have the power to select, hold and direct the same as that which of itself goes out from every true and sincere physics seeker after truth.

Dark discouragement and deep despair is sure to be the lot of every mortal man, particularly as he seeks to enter this realm of physics. Yet like the faith that lights the pilgrim's soul and carries him through the long and lonesome periods of trial and tribulation, just so there is a glow of hope that lasts until a steady purpose grips the soul of a new worker in our field.

To him who seeks to work in our domain we can not show success as judged by worldly standards, we can not say his road will be less hard and less long than ours. We certainly can not promise aught