to her supreme national selfishness. Unfortunately, some of the nations which have condemned her so unsparingly are not free from the same fault.

As so often happens, Professor Ostwald is very much better in his conduct as a man than his philosophy might lead us to expect. In these days of international bitterness and hatred, it is worth while to recall an incident of the St. Louis Congress of Arts and Sciences. Professor van't Hoff gave an address in which he presented a masterful sketch of the historical development of chemistry, especially from the point of view of the atomic and molecular theories. In the course of the address he wrote on the blackboard the names of some of the great leaders in chemistry—such names as Dalton, Dulong and Petit, Pasteur, La Bel, Guldberg and Waage, Curie and others. At the close of the address Professor Bancroft, who was in the chair, called on Professor Ostwald. Those were the days when Ostwald and some others wished to find some way to get on without the atomic theory. He began his talk with a very kindly criticism of the address in which he proposed to substitute "energy" for "atoms" and suggested that at the hands of the Curies atoms had "exploded." Then he picked up a piece of chalk and saying "I have still another correction to make" he wrote in the name of van't Hoff at three different places among the great names on the board and in each case those who were present recognized instantly that van't Hoff, in three widely separated fields, had done work of the same fundamental and far-reaching importance as the work of the other men. It is the kindly, generous spirit shown in this incident which endeared Professor Ostwald to his students and to many others with whom he came in personal contact.

The suggestions with regard to students helping each other with their tasks are novel and striking. "It is considered at present one of the worst offenses for one child to help another solve its task. *Is, then, mutual willingness to help a characteristic so exceedingly general that it must be systematically done away with in school?* Is not, rather, egoism and narrowmindedness a fault under which we suffer severely? I do not hesitate to express the conviction that a considerable amount of this illiberality is imparted to our growing youth in school by the prevalent notions regarding this mutual help and the usual treatment of it." So far, good, and worthy of consideration in our treatment of children and of students. But the corollary is not so good—"others learn at an early age that in their advancement they have need of the assistance of better endowed ones, and, what is the best thing for all of them, they learn subordination and how to work in rank and file"—a picture of a world where some are born to rule and others to be ruled. How different from the democratic ideal, where these same differences still exist and always will exist, but where men should work together, not as superior and subordinate, but each according to his ability, for the common good.

We can not take the space for a more detailed criticism of the addresses. While the author of this review dissents most earnestly from a part of the philosophy which lies at the foundation of the papers, there is very much in them which is sound and worthy of most careful study.

William A. Noyes

SPECIAL ARTICLES

DROUGHT AND THE ROOT-SYSTEM OF EUCALYPTUS

In the fall of 1913 the eucalyptus trees, especially the *Eucalyptus globulus* in the Arboretum of Stanford University, were evidently dying. Various persons questioned the members of the Department of Botany here as to the reason for the grave appearance of these large trees and none of us was able to give an answer satisfying to himself. For this reason we undertook to determine the cause of the trouble.

By permission of the business office we tapped various trees with an auger to the heart and found that the wood and bark were entirely free from disease of any sort. The

trouble manifested itself in the change of color of the foliage, the leaves turning brown as if burned or killed by frost, and drying out and presently beginning to fall. The leaves which fell showed no sign of fungus or bacterial infection. We were therefore forced to conclude that the trouble was further down and we were compelled by the condition of the trunk to suspect that the difficulty was either between the trunk and the leaves or below ground. As we had no convenient means of climbing the trees to make any examination of the branches, we concluded to look at the roots first.

By laying bare the more superficial part of the root system with pick and shovel, we found that the large superficial roots had been broken through at various distances from the trunk by the heavy plows which, up to that time, had been used in the spring, for a number of years, to clear the ground under the trees of weeds. The deep ploughing had resulted in the serious injury, the wounding or amputation, of all the roots to a distance of twelve or fourteen inches below the surface. In this way the roots, absorbing moisture from the upper layers of the soil, were either very seriously limited, or absolutely destroyed, as regards their capacity for absorbing water; and the soil water supply of these trees came therefore through the taproot or its deeper branches and from the branches running vertically downward from the underside of the uninjured lateral roots, from distances below the surface, of which we have no means of knowing anything. Whether one half or what other proportion of the absorbing surface of the root was thus destroyed we also have no means of knowing. The condition of the roots led us to suspect that this might be the cause of the condition, deplorable in appearance, of the blue gum trees throughout the Arboretum.

We were confirmed in this suspicion by examining the root system of the Monterey cypress (*Cupressus macrocarpa*) tree growing close to the big eucalyptus tree previously examined. We were interested to find that the horizontal roots of the Monterey cypress grew enough deeper in the soil entirely to escape the heavy plows which had wounded or amputated the roots of the eucalyptus. This Monterey cypress tree presented none of the deplorable features of the eucalyptus trees, for although its foliage was dusty, it was green and far from dying. We therefore concluded that the trouble with the big blue gum trees of our Arboretum was lack of water, due to an impaired root system.

That this suspicion was justified we believe is confirmed by two additional observations. Many of the eucalyptus trees which were evidently dying, as indicated by the brown color of the leaves, were cut down. Those that were cut down early enough, promptly stump sprouted, and have since grown up into promising young trees, borne on the old butts. By thus drastically reducing the evaporating surface, the water absorbed by the roots was conserved and the quantity became immediately adequate to meet the loss. Additional confirmation of our suspicion has been furnished during the last two years.

In the winter of 1917–18 there fell in Palo Alto scarcely more than eight inches of rain. In the following autumn there was no sign of injury among the eucalyptus trees, of which there were still many in the Arboretum. To be sure, many of the larger and finer had been cut five years earlier, but enough were left to show damage if the damage had been present, for the rainfall in the rainy season of 1917–18 was about an inch less than in the fifth year preceding. Furthermore, although the rainfall in Palo Alto in the rainy season of 1918–19 was approximately twenty-three inches, there has been practically no rain since early March until late September; and there is not yet a total of one inch of rain in the immediate vicinity of the Arboretum, though there is no sign of drought among the eucalyptus trees.

The manner of keeping down the weeds in the Arboretum, however, has been changed, since our observation of the injury due to deep ploughing, and the disk harrow or spring tooth harrow are all that are used for cutting down and keeping down the weeds which are

necessarily numerous on the floor of an open woods like our Arboretum. The necessity therefore of protecting the superficial parts of the root system, even of a deep-rooted tree like blue gum is perfectly obvious from the foregoing description.

One more conclusion can be drawn from these observations. The Monterey cypress above referred to, was growing at no great distance from the eucalyptus trees but was in no wise impoverished by its more rapidly growing neighbor. There is a general impression, based no doubt on a certain amount of accurate observation, that the eucalyptus is a bad neighbor and that trees, shrubs, and herbaceous plants set too close to eucalyptus trees will suffer for lack of water. The above observation shows that if the plants set near eucalyptus have the habit of sending their roots lower than the superficial part of the root system of the eucalyptus, such results will not follow.

Therefore, it would seem to be possible, notwithstanding general belief to the contrary, to plant trees and shrubs fairly close to eucalyptus providing they can get along with the amount of light which the growing eucalyptus will keep from reaching the surface of the soil. This may make possible the fuller utilization of areas of soil already carrying a certain number of eucalyptus trees.

James McMurphy,
George J. Peirce
Stanford University,
November 1, 1919

THE MATHEMATICAL ASSOCIATION OF AMERICA

The fourth annual meeting of the association was held at Columbia University on Thursday and Friday, January 1 and 2, 1920. A joint dinner with the American Mathematical Society occurred on Wednesday evening. About 150 were in attendance at the various sessions.

The general topic for all sessions was "Mathematics in Relation to the Allied Sciences." The program was as follows:

"Mathematics for the physiologist and physician," Dr. Horatio B. Williams, assistant professor of physiology, College of Physicians and Surgeons.

"The regular solids and the types of crystal symmetry," Dr. Paul L. Saurel, professor of mathematics, College of the City of New York.

"The mathematics of physical chemistry," Professor George B. Pegram, dean of the school of mines, engineering and chemistry, Columbia University.

"The mathematics of biometry," Dr. Lowell J. Reed, associate professor of biometry and vital statistics, Johns Hopkins University.

"An experiment in the conduct of freshman mathematics courses," Dr. F. B. Weley, professor of mathematics, Denison University.

Preliminary report of the National Committee of Mathematical Requirements, Dr. John W. Young, professor of mathematics, Dartmouth College.

"Mathematics for students of physics," Dr. Leigh Page, assistant professor of physics, Yale University.

At the business meeting the election to membership by the council of 73 persons and two institutions was announced. The treasurer's report showed receipts of $4,728 on 1919 business, expenditures (up to December 15, 1919) of $4,317, and an estimated final balance of $2,050 for the end of the year 1919.

The result of the election of officers was as follows:

President: David Eugene Smith, Columbia University.

Vice-presidents: Helen A. Merrill, Wellesley College, and E. J. Wilczynski, University of Chicago.

Additional members of the Council (to serve until January, 1923): R. D. Carmichael, University of Illinois; E. R. Hedrick, University of Missouri; H. E. Slaught, University of Chicago, and J. W. Young, Dartmouth College.

To fill the vacancies caused by the election of Professor Wilczynski to a vice-presidency and the reappointment of Professor Slaught as manager of the *Monthly*, the council appointed as members of the council E. L. Dodd, University of Texas, and Oswald Veblen, Princeton University.

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