on rhizomes is *Carex limosa,* or mud sedge, of northern America and Europe. (Other species of sedge which occur in acid-free substrata have similar root systems).

The rhizome of *C. limosa* is long, branched and has long internodes.[2] It is superficially placed in the substratum. The most striking structural feature is the internodal development of large chambers, which, in effect, are storage chambers for gases, especially for oxygen.

The adventitious root system is dimorphic, consisting of adventitious or main roots which are relatively slender and much branched, and main roots which are relatively thick and which may or may not bear laterals. There are, thus, really two kinds of thick roots, branched and not branched. The slender and thicker main roots have unlike origins. The slender roots arise at the base of flower shoots; the thicker roots are formed at the base of leafy shoots.

Root hairs occur abundantly on nearly all the roots. The thicker main roots have aerating tissue composed of 10 to 15 rows of intercellular spaces, arranged radially.

It has been observed (Metsävainio) that the roots with prominent intercellular spaces may penetrate deeply; those without it are usually superficial. The crucial structural difference between the two is evidently the presence or the absence of aerating tissue.

It will be recalled that other herbaceous hydrophytes also have well-developed intercellular spaces or chambers, for example, Elodea and Equisetum. Those of the former may, when the plants are in sunshine, contain much oxygen, derived from carbon assimilation. And, in certain scouring rushes the air chambers are the most prominent features both of the shoot and of the rhizome. It is because of this that the rhizome, as in *E. fuviatale,* may penetrate deeply in a wet, or saturated substratum. An analogous condition appears to obtain in some sedges which have aerating tissue not only in the rhizomes but also in the thicker main roots, and the origin of these roots at the base of the leafy shoots has, from this point of view, great significance. They may also be storage organs for oxygen, especially oxygen of internal origin.

From these and other considerations it is concluded that the slender and much branched main roots, without prominent intercellular spaces, and which are shallowly placed, derive the oxygen they require from the well-aerated soil atmosphere immediately around them. It, in fact, is because of this readily obtainable oxygen that these roots have laterals. The thicker main roots, on the other hand, which have aerenchyma, develop and live where the oxygen supply is limited, but they are able to secure the necessary amount from the rhizome and/or chlorophyll-bearing shoot. It is because of this that they live under poor conditions of aeration in spite of the relatively small water-absorbing and *oxygen*-absorbing surface.

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[2] K. Metsävainio, *Ann. Bot. Soc. Zoolog.-Bot. Fennicae Vanamo,* 1. Helsinki. 1931.

HARDINESS OF THE PAPER-MULBERRY TREE

A TREE that supplies paper to part of Asia and materials for clothing to many Pacific islanders was formerly much planted in the United States.

This curious tree *Broussonetia papyrifera* Vert. is said to be hardy up to New York City and also to sometimes escape and spread, naturally, though the sexes are in separate trees. "Is the female of the species more tender than the male"? was a question not to be answered by the Arnold Arboretum, as outside the climatic limit of this tree. Possibly some reader of SCIENCE may know the answer.

In Baltimore, Md., many of these trees flourished in yards, being introduced by Jesuit Fathers, it is said. But as far as known all the trees here are staminate or male and not capable of colonizing new localities. Yet in North Carolina one sees the strange flowers and the mulberry-like fruit that might spread seed to new regions. In Florida also female trees are found.

When, on different occasions, little female trees from Florida were planted in Baltimore, they flourished exceedingly all summer, but failed to survive the winter, as the male trees do.

It may be that this tree is exceptional and that both sexes are not equally hardy and thus the limits of its natural distribution would be set by one sex while artificially by man the other sex may be grown over a wider area. Is there such a physiological difference?

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THE GALTON LABORATORY

YOU were good enough (November 10) to reprint for the information of readers of SCIENCE, the letter of protest which I wrote to the London *Times* on the obstacles placed in the way of the Galton Laboratory continuing its researches. It is now possible to give a somewhat fuller view of the situation.

Many of the constituent institutions of London University are again active. The London School of Hygiene and Tropical Medicine, for example, situated only a few hundred yards from University College, along Gower Street, has its library and main departments open. I have been unable to ascertain, even if undergraduate teaching is supposed to be safer elsewhere, why research departments should be forbidden to continue at University College, which now stands nearly empty.

The Galton Laboratory has established its right to continued existence, though it has been forced to leave London. Sir John Russell was kind enough to find it

space at Rothamsted, and the college has withdrawn its ban on the attendance of my assistants. Apart from small sources of income, such as the sale of mice, we must rely on the income of Francis Galton's trust, and this will suffice to make sure that the work he initiated will be continued.

It has been suggested to me that many American friends, who would be glad, from time to time, of statistical assistance and advice, have refrained from writing in the belief that I should be too busy. This is not so. I should, indeed, be glad to earn some support for my department by such professional services. Any sympathizer who considers that we could supply assistance worth $100 towards his own researches is invited to put up a problem; though I must add that I should be sorry if this offer were to prevent any friend, who might otherwise write to me for advice, from doing so as freely as before.

R. A. FISHER

ROTHAMSTED EXPERIMENTAL STATION,
HARPENDEN HERTS, ENGLAND,
GALTON LABORATORY

QUOTATIONS

CHEMISTRY IN THE SERVICE OF THE STATE[1]

I HAVE been invited to represent the State of Oregon in this dedicatory exercise. This building, erected under state auspices as an important structure on the campus of this state college, may appropriately claim the attention of the chief executive. So I bring you greetings in my official capacity, and tender my congratulations on this consummation of the hopes of the scientists and administrators connected with this institution and the state system of higher education.

Your committee on arrangements has appropriately planned a symposium to-day, with learned scientists invited as participants, in which certain phases of this great science of chemistry are being discussed. In such a forum I am not qualified to take part. In fact, as a representative of the political agency I appear here with a certain sense of humiliation. I realize that from time immemorial the political arm has seized the knowledge of the experimenter and the scientist for ignoble ends. This is particularly true of chemistry and its ally, physics. From the days of the crude catapult, from the time when Greek fire was used to destroy the enemy ships about Byzantium, from the time when the new mixture of saltpeter, charcoal and sulfur was used to hurl missiles with death-dealing force, down to the present day with its high explosive shells, its poison gas, its armored tanks and flying bombers, government has used the discoveries of science in the business of warfare and the killing or mutilation of enemies. To-day it almost seems as if government leers over the shoulder of the patient chemist and urges him to compound some deadlier substance for the destruction of his fellowmen. In this respect Dr. Faustus remains the symbol of chemistry: with all its aspiration to conquer matter in the service of mankind, its soul remains in pawn to the devil. For organized society persists in devoting the discoveries of science to diabolical designs; or ignores the evil consequences which attend the application of such discoveries.

The central problem of our time becomes therefore not so much scientific as ethical and philosophic. How can we employ the products of science for beneficent ends! Science itself is amoral. It is the use made of science which determines its moral coloring. The potion which Friar Lawrence gave to Juliet was only a soporific, from which after two and forty hours she would "awake as from a pleasant sleep." The dram which Romeo forced the hungry apothecary to sell him was so potent a poison that "if you had the strength of twenty men it would dispatch you straight." But in the complexities of modern life the line of demarcation between the good and evil uses of scientific discoveries is not so clear as between the harmless sleeping potion of Juliet and the deadly poison of Romeo. A new machine or a new compound creates social as well as economic reactions. Therefore as the scientist reveals more the secrets of nature and points the way to their utilizations, the philosopher, the economist, the moralist, the statesman must labor alongside of him lest man become the victim of his own intelligence.

I have one more thought. You here dedicate a building to a use. May I as governor of this state dedicate it to a principle: the fearless search for truth. That is a concession the political arm is sometimes loath to give, for usually government seeks to keep its branches subservient to the regime. Yet if there is anything which modern science stands for it is the quest for truth. In spite of resistance sometimes clerical and sometimes political that quest has proven its virtue. Now generally accepted in the field of the natural sciences, that principle meets opposition at times in its extension to the area of social relationships. Yet it is in this field there now are occurring those gropings which often eventuate in new experiments or new discoveries.

Let this building stand dedicated to the service of

[1] Address of the Honorable Charles A. Sprague, governor of Oregon, at the dedication of the new Chemistry Building of the Oregon State College at Corvallis.