

A Vegetable Partnership

Some Data on the Lichens, Recently Proposed in Germany as a Source of Food

By Albert A. Hansen

THE shortage of food in Germany due to the present war has caused a great deal of investigation on the part of German scientists to find suitable substitutes for staple articles of diet. One product of this investigation is the recent work of Dr. C. Jacoby, published in two volumes under the captions "The Lichens of Germany as Food and as Fodder" and "Reindeer Moss and its Utilization as Fodder."

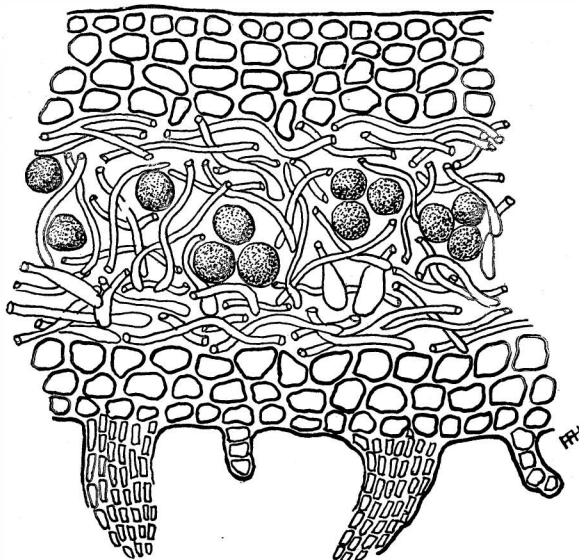
In these books it is proposed that the lichen, commonly known as Iceland Moss, be utilized as food for man in the form of flour from which bread may be made, and that Reindeer Moss, another lichen which grows abundantly in some parts of Germany, be used as fodder for animals. The reports which have reached this country regarding these books have aroused a great deal of popular interest in the lichens. It is the purpose of this article to state briefly some of the most important facts regarding this highly interesting group of plants.

Lichens have long been known and described. They are among the commonest of our plants, being found from pole to pole and in all sorts of situations from bare rock to rich forests. In every clime from frigid to torrid, on exposed ledges and on practically every tree in our forests, the lichens exist in abundance. They usually form their greatest display on the north side of the tree, a fact which has frequently been found valuable, especially among the Indians and the early settlers, as guides in the forest.

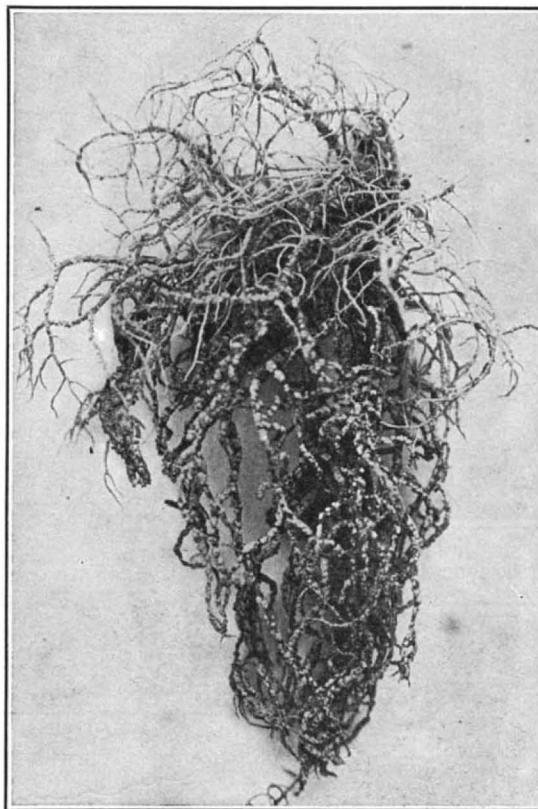
Structurally, a lichen is exceedingly interesting; it is essentially a partnership of two plants, a fungus and a green alga. The alga is held captive within the mass of fungal threads; this explains the greenish color assumed by the lichens during wet weather. The alga, being ordinarily an independent plant, is able to manufacture food, some of which is given over to the fungus. In return the fungus protects the alga and supplies water, thus paying in part for its keep. Since the alga can live independently of the fungus, but the fungus is entirely dependent upon its green companion for food, it is probable that the algae are held in more or less of a captive state; in some species attempts are apparently made to escape. In a great many cases, however, the alga seems satisfied to remain a member of this curious plant partnership. In only one case, that of the Cora lichen of Brazil, has it been demonstrated that a lichen fungus is able to live independent of the alga companion.

The lichens are remarkable for the great age to which they attain. There seems to be no accurate data concerning the time necessary for these plants to die of old age. Individual plants have been carefully watched for twenty-five years, with no apparent change in their size. In the minds of some, the age of members of certain species of lichens can be estimated in centuries, this being especially true of the highly colored rock lichens. It must not be supposed, however, that all lichens are slow growers; some attain large sizes in a short space of time. The study of lichens on tombstones often gives us a clue as to the age of the plant.

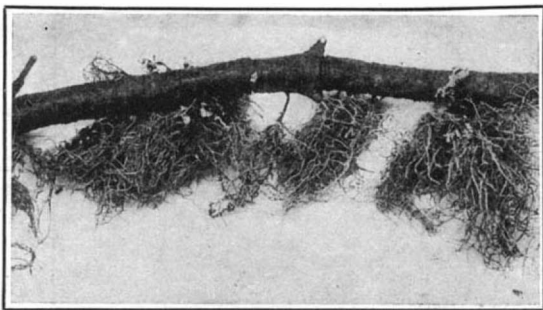
The reproductive methods of these organisms are extremely interesting. Upon their surface, dust-like masses of what are technically termed soredia are frequently found. Each tiny soredium consists of a few fungal threads surrounding one or more algal cells. These soredia are scattered by the wind or rain, each soredium being capable of creating a new lichen. The commonest method of reproduction, however, is by means of large numbers of spores produced in the tiny saucer-shaped fruiting bodies, which may frequently be ob-



Cross-section of typical lichen. The balls are algae, the rods fungi. Below are seen the root-like processes for attachment to rock surfaces



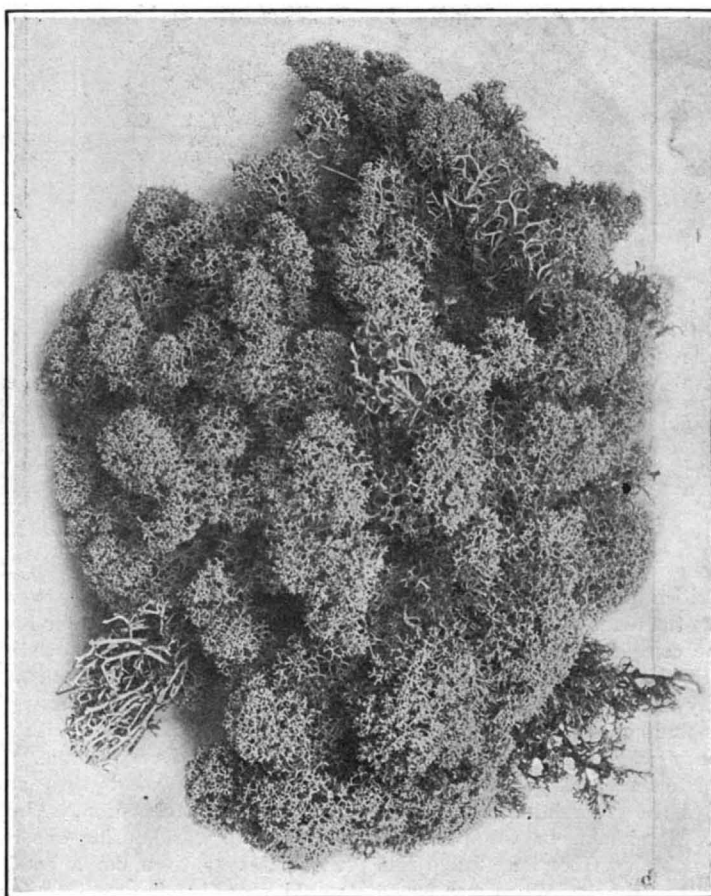
Masses of the soredia by means of which the lichen effects its asexual reproduction



Old Man's Beard, the most picturesque of all our lichens. Specimen from northern Wisconsin



Ramaline, a lichen abundant on living and dead trees throughout the western states



Reindeer moss, really a lichen

served on the surface of the plant body. These spores are disseminated by wind or rain, finding ready lodgment in the crevices of rocks or bark. Upon germination, it is necessary for the tiny germ tube to come into contact with cells of the proper alga in order to produce an offspring. This is usually not so difficult as one would at first imagine, since at least one of these algae, the *Pleurococcus*, is of such common occurrence in nature as frequently to form a greenish coating on fences, the bark of trees, etc. In fact, one of the first methods of demonstrating that lichens are really two plants instead of one was the bringing together of appropriate lichen germ tubes and algal cells. These experiments were first performed by Schwendener and Bornet in 1868 at the suggestion of the eminent botanist, De Bary.

Previous to 1868, scientists held most peculiar ideas regarding the nature and origin of lichens. The old doctrine of spontaneous generation was especially applied to the lichen group. They were accused by the most eminent philosophers of being created out of solid rock. Still others believed them to be the product of decomposing water. The algal cells were generally looked upon as reproductive bodies, even the term spores having been applied to them. From about 1825 these views came to be regarded with some suspicion, but little doubt was openly expressed, since no one had better theories to offer. Since the researches of Schwendener and Bornet, however, it has been conclusively demonstrated that lichens do consist of a dual plant alliance, in which, as has been previously explained, there appears to be a distinct division of labor.

The economic importance of this remarkable group of plants is far greater than is ordinarily realized. The first record of their practical use is contained in the Bible, since it has been almost definitely demonstrated that the manna which was such a boon to the children of Israel was the Manna Lichen, known scientifically as *Lecanora esculenta*. During certain seasons of the year, this plant dries and hardens, forming warty grains, which fall in showers from the mountain sides into valleys; these are used as food in Algeria, southwest Asia, and the Steppe region. The grains form an acceptable substitute for corn. The Manna Lichen is famous for its ability to withstand heat, a temperature of 70 degrees C. being insufficient to cause death.

The ancient herbalists studied the lichens with the view of using them as medicines. The influence of this is still felt, as it is common belief among some people that any real or imaginary resemblance of lichen to some part of the human body can be used as a cure for any disease of the resembled part. Thus the Lung Lichen (*Sticta pulmonaria*) is famous as a cure for lung troubles. The Old Man's Beard (*Usnea barbata*) was until recently used to promote growth of hair. The Yellow Wall Lichen (*Xanthoria parietina*), finds use as a treatment for jaundice; and on account of the resemblance of the

marginal fruits to canine teeth, the Dog Lichen (*Peltigera canina*), has been considered as a specific for hydrophobia. Some of the lichens do occupy a legitimate place as sources of medicine, as for instance the Iceland Moss, the extract from which is used as a stomach medicine. Their therapeutic use, however, is rapidly declining.

The lichens are justly famous for their work as soil formers. Usually they are the first plants to attack bare rocks. Into the microscopic fissures of the rock they send tiny processes called rhizoids, which enlarge these crevices by the secretion of acids. The entrance of moisture, with the consequent expansion due to freezing, chips off minute frag-

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ments of rock, which, added to the organic matter from decayed lichens, is the first step in soil formation. Who knows but that a similar process was responsible for much of the early soil formed upon this earth?

The use of lichens as sources of dye is of long standing. The famous blue and purple dyes of the East, so frequently mentioned in history, were in all probability extracted from the Rocella lichen, which has in recent times been extensively used in France for the gorgeous coloration of silks. Lichen dyes are secured by pulverizing the plant body, termed the thallus, and applying alkali to extract the coloring matter. One lichen dye, litmus, finds wide application in the science of chemistry.

The greatest economic importance, however, of this strange group of plants is, perhaps, that suggested by Dr. Jacobj, namely, their value as a source of food for both man and beast. The reindeer moss, (*Cladonia rangiferina*) is well known as the main source of sustenance for the reindeer and caribou of our northern regions. During the winter it is the only food supply of these animals, who need only to poke their noses through the snow or scrape it away with their antlers in order to get a nutritious meal. Great browsing fields of reindeer moss exist in many parts of the Arctic region, and are used alike by the wild reindeer and the domestic herds of the Laplander. It is this plant which is proposed by Dr. Jacobj as the main source of fodder. It could probably be similarly utilized in this country, as the writer has personally seen great masses of this lichen growing along the shores of Lake Superior, and large crops undoubtedly exist in other parts of the United States. In northern Minnesota, patches covering an acre or more of ground are not infrequent. According to Dr. Jacobj, reindeer moss when boiled in whey forms an excellent and nutritious fodder. Its food value is said to be three times as great as that of the potato. In former times reindeer moss was used in the production of sugar and alcohol and was also utilized by the people of Sweden as a flour for bread making.

For human consumption, Dr. Jacobj recommends the Iceland Moss (*Cetraria islandica*). Previous to the introduction of gelatin this plant was used in the preparation of jellies. Iceland moss in the raw state contains a bitter principle which may be removed by allowing the plant to stand in a one per cent solution of potash for about three hours. The bitterness passes entirely into the resulting extract, which is the stomach medicine previously mentioned. Thorough washing in water will serve the same purpose. The lichen is then dried, powdered, and mixed with an equal part of flour. The resulting compound is said to be an excellent flour for bread-making. In our northern regions, the flour made from the Iceland Moss is used for making not only bread, but also pancakes, which are said to be excellent.

With increased knowledge of the growth of lichens, perhaps, these suggestions coming from Germany may find ready application in the United States, and the lichen farmer may not be an impossibility of the future. It is even possible that waste lands in some parts of the country may be utilized in the growth of lichens, if they are found to be of the practical importance suggested in the works of Dr. Jacobj.

Kapok for Explosives

SINCE the war, exportation of cotton is prohibited in France, because all the available supplies are needed for the manufacture of explosives, and it is now found that the substance known as kapok, which has already been described in our columns, answers as a substitute for cotton. This fact was brought out by the chemist André Arnoux, who showed that kapok, treated in the same way as cotton, was at least equal to it for explosives. He found an improved method of treating kapok, which is not made public. Kapok is to be classed on the same basis as cotton, and garments wadded with it must not be sent to prisoners of war in Germany.

NEW-YORK LIFE

INSURANCE COMPANY

346 & 348 BROADWAY . . . NEW YORK CITY

TO THE POLICY-HOLDERS AND THE PUBLIC:

A brief of the chief activities of this Company during 1916 runs as follows:

New Paid Business \$263,048,300.00

Of this total \$239,090,873 was secured in the United States.

Total Income \$138,559,395.79

From New Premiums \$10,241,497.43
From Renewal Premiums \$82,843,015.14
From Interest and Rents \$38,108,768.16
From miscellaneous sources (exclusive of increase
in Book Value of Assets) \$7,366,115.06

Total Payments to Policy-holders . \$81,415,138.36

In Death Losses \$29,332,346.32
In Endowments \$11,384,424.69
In Dividends \$19,695,355.33
In Surrender Values \$19,551,361.00
In Annuities \$1,414,154.02
In Disability Claims \$37,497.00

Significant Facts:

Mortality Rate reduced
Expense Rate reduced
Interest Rate increased
New Business increased

Invested During the Year in Bonds and Mortgage Loans \$70,717,602.17

To pay 5.26%.

Added to Legal Reserves \$24,676,393.00
Market Value of Assets, Dec. 31, 1916 \$866,988,841.57
Legal Liabilities \$728,226,426.34
Reserved for Dividends and Contingencies \$138,762,415.23
Outstanding Insurance \$2,511,607,274.00

Represented by 1,228,601 policies.

The actual mortality of the Company expressed in the per cent. which it bears to the expected death losses according to the tables of mortality adopted by the State for valuation purposes through a period of years is as follows:

1912 Actual death losses 76% of the "expected"
1913 Actual death losses 73% of the "expected"
1914 Actual death losses 73% of the "expected" (5 mos. of war)
1915 Actual death losses 73% of the "expected" (12 mos. of war)
1916 Actual death losses 71% of the "expected" (12 mos. of war)

The Seventy-Second Annual Statement of the Company will be filed at once with the Department of Commerce in Washington and with each State of the United States and each country where we do business. A brief of that statement will be sent gratis to any person asking for it.

DARWIN P. KINGSLEY,
President