ning salt water, after a few struggles it turned on its side and so remained, seemingly in considerable distress, being unable to maintain itself in the normal position by its delicate filament-like ventral fins which are intramandibular in position.

I then filled a tall glass jar some eight inches deep with fine sand, introduced into it the little fish and placed it under a salt water jet. At first the fish lay quiescent on the sand, but when I returned some hours later, it had burrowed into and was never again seen on top of the sand. Frequently, however, the little fish could be seen with its body half outlined against the glass side of the aquarium. There could then be seen slow undulations of the long dorsal and anal fins together with slight bendings of the body, both motions beginning at the head and progressing towards the tail. Evidently by this means a current of water was maintained through the gill-chambers. On the surface of the sand, small conical half-filled depressions could be found. These seemed to have been formed by the fish either in burrowing into the sand or in drawing water over the gills. However, I did not notice any distinct currents through these depressions and can not positively say that they were excurrent and incurrent openings. But I am sure that there were no distinct burrows, the wet sand not having sufficient consistence to remain in shape after the withdrawal of the fish.

Bits of oyster were put into the aquarium as food for the fish, but as these were never counted I could not be sure that any had been eaten and as it was impracticable to make later an examination of the contents of the stomach of the fish, nothing can be said as to its food.

Since this fish was of no value as a live museum specimen, and as I feared that it might die of starvation, it was killed and later identified as *Rissola marginata,* one of the cuskeels. It is a cause of considerable regret that press of other work prevented a more complete study of the habits of this interesting little fish. This specimen is now in the Museum of the laboratory of the United States Bureau of Fisheries, at Beaufort.

E. W. GUDGER.

INTERNAL INFECTION OF THE WHEAT GRAIN BY RUST—A NEW OBSERVATION.

THERE are many species of the rust parasites (Uredinales) found upon cereals. Almost every type of cultivated grain is attacked by its own particular type or form of rust. These rusts are minute, thread-like, filamentous affairs. The threads are very much more minute than the branching spawn met with in mushroom culture. The threads branch very generally and spread through the tissues of the host plant in various directions. They are able to penetrate all of the soft parts of the plants upon which they live. It has usually been supposed that the threads did not spread far from each point of new infection. The filaments usually gain admission to the tissues of the leaves and stems by eroding or boring through the skin layer from the outside. Later the branching filaments become massed at certain points under the skin layer of the host plant. They then produce countless numbers of small ovoid or rounded bodies called spores. These spores are cut off or rounded off from the ends of the filaments, pressing outward under the skin layer of the host. As the spores mature, the size enlarges, and thus the skin or epidermis of the host plant is broken and pushed outward. This allows the spores access to the air and they are then carried by the wind and other agencies from plant to plant and from field to field, perhaps hundreds of miles by wind storms. Countless numbers fall to the ground and do no harm; but countless numbers are produced and thus some of them are sure to reach other host plants. This is the usual method of accounting for the spread of wheat rust.

It has usually been assumed that rusts grow only in the leaves and stems (*vegetative parts*) of their hosts, but gradually it has been learned that amongst many perennials, certain weeds and shrubs these parasites send their filaments (*hypha*) into other more permanent structures, as, for example, roots and woody stems, thus becoming perennial with the host. Observations and experiments at this experiment station have gradually convinced us of the probability that rust of wheat may sometimes thus persist. Our field experi-

ments have often suggested that rust, at times, either attacks wheat from the soil in some form or manner, not now known, as characteristic of the life history of rust, or that it may come in some manner from the seed. This will at once suggest to those who are familiar with the investigations upon the rusts of cereals, the studies conducted by Professor Ericksson, of Stockholm, and his odd and undemonstratable mycoplasm theory. That author by his experiments seems to have demonstrated that in some manner a rust of wheat (*Puccinia glumarum*) of that region can be transmitted by the seeds, and claims to have demonstrated by structure studies certain micro-protoplasmic bodies directly associated with the cellular structure of the young wheat plant in such a manner that they are able to transmit the rust infection by finally transforming into filamentous structures in the aftergrowth from the embryo.

Through persistent studies upon this phase of the rust question we are now able to point out a more rational possible explanation of the transmission of rust through the seed of wheat, if it really ever is transmitted in that manner. Professor Ericksson in his experiments enclosed wheat from the time it was seeded until the time of maturity in certain germ proof glass cages and found that rust still appeared in the crop.[1] Bolley at the North Dakota Experiment Station several times duplicated this work.[2] He used sound wheat grains externally treated and in no case was able to secure rust under the conditions of culture; that is, was unable to confirm the results of Ericksson. It is possible that the wrong kind of wheat was selected in order to prove this work. In the experiments just cited, Bolley used the best selected grains of a particular kind of wheat which was known to rust easily. It was not certain, however, that the grains used had grown on rust-attacked mother plants. Late observations at the North Dakota Experiment Station Botanical Laboratory, in which numerous samples of wheat harvested from the badly rusted crop of 1904 were examined, now allow us to make the definite statement that wheat grains from badly rusted mother plants quite often, indeed, in some strains are quite uniformly internally infected by wheat rust filaments to such extent that spore beds are formed bearing both uredo-spores and teleuto-spores (*summer spores and winter spores*) beneath the bran layer. In some samples of the rust-infected crop of 1904, as high as thirty per cent. of all grains harvested were so infected with the stem rust (*Puccinia graminis*) and spore beds bearing both types of spores were found variously located beneath the bran layer of the grains and about the embryo wheat plants. The spots or spore beds are most commonly located immediately at the germ end, causing a black or blighted appearance, but are often found on other portions of the berry, especially along margins of the grooves. It is also found that these grains, thus affected, germinate as freely as any other wheat grains.

These new observations have opened up a new line of investigation, but it is too early to affirm that wheat rust attacks may come in this direct manner from the seed. If, however, later experiments should confirm this possible mode of rust propagation, these observations must undoubtedly throw a new light upon the Ericksson mycoplasm controversy and place another strong emphasis on the importance of proper seed selection and grading of grain in farm practise. The fact that rust thus attacks the wheat grain by way of its attachment is also an apparent explanation of why rusted wheat often fails to properly mature the seed even though there is yet plenty of strength in the parent plants.

Henry L. Bolley,
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North Dakota Agricultural College,
July 11, 1905.

[1] Dr. Jacob Ericksson, 'A General Review of the Principal Results of Swedish Research into Grain Rust,' *Botanical Gazette*, Vol. XXV., No. 1, 1898.

[2] Bolley, in *Centralblatt für Bacteriologie, Parasitenkunde und Infectionskrankheiten*, Zweite Abteilung, IV. Band, 1898, Nos. 23, 24 and 25.

APPARATUS TABLES FOR ELECTRICAL LABORATORIES.

The apparatus tables, here described, were designed to meet the needs of an advanced laboratory in electrical measurements. The