

the same people with themselves, having at some time in the past had but one camp-fire, and it was generally believed that they would show some full-bloods of pure strain. This proved to be a vain hope. On close inquiry all sorts of mixtures were discovered, even among the oldest men and women of the tribe, but no pure-bloods. Only one single woman of middle age was believed to be possibly a full Kickapoo, but there was no real certainty. Some visiting Kickapoo from Mexico proved no better than the rest, and no hope was given that any pure strain Kickapoo could be found anywhere else.

Thus two tribes, one of which was of considerable importance, may be regarded as lost to science, so far as pure-bloods are concerned. Only a few years ago according to local information there were still a number of old men and women living in both tribes who represented the pure strain. The genuine Indian is rapidly passing away and the work of the anthropologist who endeavors to record the physical type of the various tribes is becoming increasingly difficult.

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ON A SUDDEN OUTBREAK OF COTTON RUST IN TEXAS

IN June 10, 1917, the attention of the writer was called to an outbreak of cotton rust. The specimens were first collected at Mercedes and Edinberg, Texas. A review of the literature seemingly showed that in the United States, the cotton was supposed to be free from rust. The Experiment Station Literature however refers to cotton rust which is not a true rust, but various leaf spots caused by *Pseudomonas malvacearum* E. S. and *Glomerella gossypii* (South.) Edg.

Symptoms.—The disease is characterized by circular spots which vary from one tenth to one quarter of an inch in diameter. The spots, however, are often much larger in size when they appear singly and become considerably smaller when many of them occur on the same leaf. The æcia are found to be thickly studded on the spots of the upper part of the

leaf. The æcia are typical of all rusts of this type, and when mature the spores are liberated by the least wind or touch, forming a yellow powder on the leaf. The spores readily germinate in water, showing that the rust is a heteroecious species. This same observation was also substantiated by Dr. J. C. Arthur, under correspondence dated July 2, 1917. The disease seems to attack the lower leaves first and especially plants which are well developed and on which cotton bolls have attained considerable size. The area of the present infection was found to begin at about four miles west of San Fordyce on the Rio Grande, running east about thirty-five miles and extending north and south about fifteen miles. In the Mission Sharyland district the approximate acres devoted to cotton are about 500, while further East several thousands of acres have been put to cotton this season. There were few patches in that area which were not affected with rust. About two or three miles north of Mission the first outbreak was reported from the ranch of Mr. Charles Brodgen. Soon other ranchmen reported similar outbreaks of cotton rust. The first infection was noticed immediately after a long rainy spell which lasted about three weeks. The rain consisted of short showers, which kept the air very humid. The disease was more serious on older patches and where irrigation was resorted to. Where irrigation and cultivation was slightly neglected infection was found to be very mild. In the same field in those plants which were most protected from either wind or by a top growth infection was heaviest on the lower leaves. Cotton which was planted very close and those plants in the field which made the heaviest growth were also found to be most affected. While infection is confined to the lower leaves, the disease may also be found on the bracts of the bolls. Careful observation so far has not disclosed it on the stem of the cotton plant.

It does not seem probable that this rust has prevailed to any serious extent in the Cotton States before. Some of the oldest cotton growers of Hidalgo County of Texas claim that from their experience of nearly fifty years

with cotton, they have never seen this rust. Many Mexican cotton growers on the Texas border too make similar statements, while one or two others insist that they have seen it before. It seems therefore a puzzle how this rust has escaped the general attention of cotton growers. There is this point which might be of value in considering the source of the present outbreak. The Rio Grande valley receives its irrigation water, not from the Rio Grande, as is commonly supposed, but from the San Juan river and other Mexican rivers. The waters from these rivers empty in a basin or valley in which cotton grows. It is therefore very probable that the waters of the San Juan river have introduced weeds which act as a host to the possible *Puccinia* stage of this rust. It is also probable that the waters of these rivers have carried sporidia from Mexican sources, which were now responsible for the infection of the cotton; all this however is problematical.

Cause.—The disease here reported is a true rust. The aëcial stage occurs on the cotton while the *Puccinia* stage undoubtedly occurs on some other host, unknown as yet. In submitting specimens of this cotton rust to Dr. J. C. Arthur, he pronounced it *Æcidium gossypii* E. & E. suggesting also that this rust might come from some grass form, probably *Muhlenbergia*, or *Sporobolus*; Dr. Arthur has specimens of this rust in his herbarium, which was collected by Heald and Wolf at Falfurrias, Texas, September 2, 1909, and two Mexican collections, one from San Jose del Cabos, September 2, 1893, the other from Tlahualilo, collected about 1907, probably by Herrera. Dr. W. A. Orthon¹ states that he has specimens of this rust in his herbarium which were collected in Florida found one year in an experimental plat at Miami. His other specimens came from Falfurrias and other points of the Rio Grande valley, collected seven years ago. From this it is evident that the cotton rust must have been present in Texas and elsewhere, though it did not attract the attention of cotton growers or pathologists. *Æcidium gossypii* E. & E. was first

¹ Correspondence dated July 25, 1917.

described in *Erythea*, 5:6, 1897. Unfortunately the writer was unable to secure a copy of this publication. There seems no doubt however that the present cotton rust is the same as that which was originally described as *Ascidium gossypii* E. & E. *Uredo gossypii* Lagh. is another but inconspicuous rust which attacks cotton. This is prevalent in Cuba, Porto Rico and southern Florida, twenty-seven collections of which are found in Dr. Arthur's herbarium. It is very likely that the same rust may be found to be more widespread in the cotton states, although it may be easily overlooked because of its inconspicuous nature. *Uredo gossypii* resembles very much any other ordinary *Uredo*.

A careful search of *Æcidium gossypii* in the affected district in Texas has as yet failed to reveal the presence in cotton fields of any grasses belonging to the genus *Muhlenbergia* or *Sporobolus*. On the other hand there are numerous grasses in that locality which are found to be affected by various rusts. More recent investigations have disclosed the fact that there are no new infections found on the cotton since the last outbreak was observed. Moreover the aëcial stage on the previously affected cotton leaves is now found to have dried, leaving no traces of viable spores. The original spots as well as the old cluster cups are overrun by a varied mycological flora. Just what became of the aëcial stage is hard to explain. It is not likely that new infections will start again on the cotton this year. The problem on hand therefore is to determine if possible the alternate host which hibernates the *Puccinia* stage. Drs. Olive and Arthur, as well as the writer, are now working on this phase, and it is hoped that the *Puccinia* stage will be found so that the host which hibernates it will be destroyed, thereby preventing the further spread of cotton rust.

In conclusion the writer wishes to express his indebtedness to Dr. J. C. Arthur for helpful suggestions and for identifications of specimens. Grateful acknowledgments are also due Dr. J. J. Marton, agricultural agent of the Texas State Department of Agriculture, for the hearty cooperation and for information on

the spread of cotton rust in the Rio Grande valley of Texas.

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SPECIAL ARTICLES

THE EFFECTS OF ACIDS AND SALTS ON "BIO-COLLOIDS"

MIXTURES of agar with gelatine, albumen, protein, urea or amino-acids in which the agar forms seventy-five per cent. or more of the whole, show a similarity of imbibitional behavior to that of sections of plants and hence for convenience in the present studies may be termed "*bio-colloids*." The results of a series of tests with a wide variety of nitrogenous substances from urea to albumen were in general agreement to the effect that such substances mixed in proportions of one to ten, more or less, with agar, when made into thin dried plates, swelled enormously; 2,000 to 3,000 per cent. in distilled water, one half to one tenth this amount in hundredth-molar hydrochloric acid, and more or less in hundredth-molar sodium hydrate.¹

An extension of the tests of the effects of nitrogenous substances upon the swelling of the amorphous carbohydrates was made to include a mixture of agar and peptone the swelling measurements of which were as follows:

AGAR 90—PEPTONE 10

Water	HCl M/100	NaOH M/100
3166.6%	500% (20 hours)	633%
.....	566.6 (20 hours)	800
.....	633.3 (48 hours)	1,666.6

The chief feature of interest in these results is the uniform swelling in alkali in excess of that in hydrochloric acid, in a manner slightly different to that of similar mixtures in which other nitrogenous substances were used.

¹ See "Growth and Imbibition" presented before the American Philosophical Society, April, 1917, and now in press in the *Transactions* of the society; also "The Behavior of Certain Gels Useful in the Interpretation of the Action of Plants," *SCIENCE*, 43, p. 484, 1917.

The chief purpose of the entire series of studies has been to ascertain what conditions of growth and development might be identical with the factors affecting imbibition. The fact that plant protoplasts usually consist of a large proportion of carbohydrate gels with a smaller proportion of nitrogenous material has already been discussed. The resulting colloidal mixture may be acidified as a result of certain respiratory processes, or this acid may be broken up as fast as formed, in which case the protoplast might be in a deacidified or neutral condition and from this might vary to alkaline under conditions which we are not yet ready to describe. Acidification and deacidification of the cell may take place at a rapid rate and be complete within a short time, according to the bulk of the cell-mass, temperature and other conditions.

Hydrochloric acid had been used in nearly all of the earlier work for acidification of colloids, since most of the known facts as to the swelling of gels are referable to it. The acids of the plant are organic, and a modification of the technique to heighten the similarity between the experiments and the action of the plant was to substitute citric for hydrochloric acid in the series.

Preliminary to this substitution, series of swellings were carried out to test the relative action of the two acids, with the following results from dried plates of mixtures of 90 parts agar and 10 parts bean protein:

Hydrochloric Acid M/100	Citric Acid M/100	Sodium Hydrate M/100
541.6%	916.6%	916.6%
	875	
	875	
300	402	400

The effect of this organic acid in this initial series of tests was to produce an imbibitional swelling fairly equivalent to that of sodium hydrate and to cause such colloidal mixtures to take up more water than in hydrochloric acid. An extended series of measurements will be necessary before any serious conclusion can be formulated, however.

Another set of factors arising from the presence and concentration of salts is next to