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BUREAU OF ENTOMOLOGY.

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THE STATUS OF THE COTTON BOLL WEEVIL IN 1909.[a]

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AREA INFESTED.

All the regions in which the cotton boll weevil was known to occur in 1909 are shown on the accompanying map (fig. 1). It will be noticed

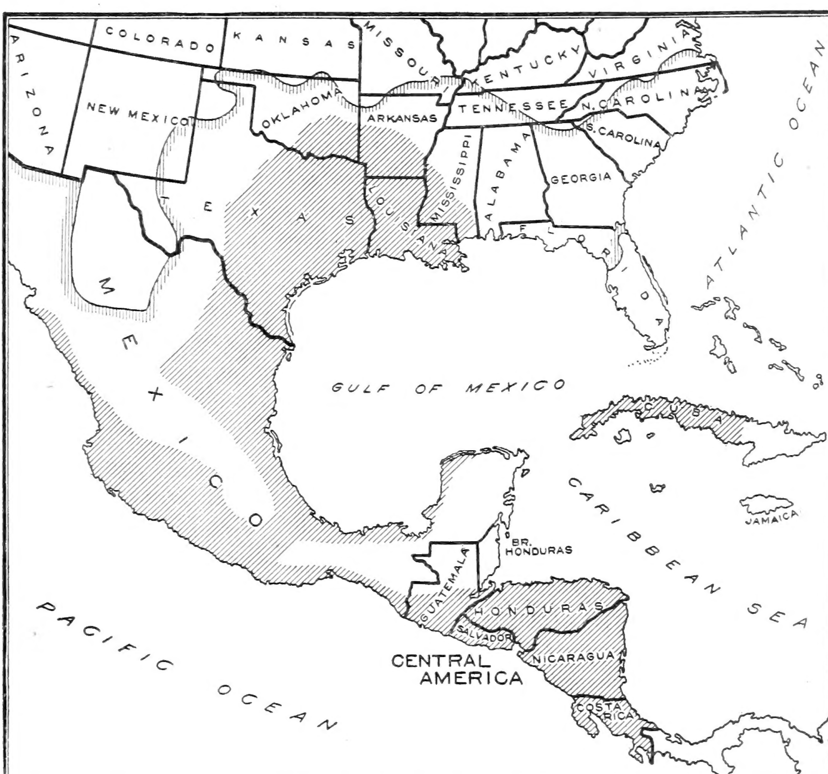

FIG. 1.—Map showing the regions in which the cotton boll weevil occurred in 1909.

that outside of the United States the insect occurs only in Mexico, Central America, and Cuba. The infested area in Texas covers all

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[a] The statements in this circular regarding the territory infested by the boll weevil cover the advance made by the insect up to the close of the year 1909. Since that time it has extended its range in the United States considerably, as will be shown in a map soon to be issued by the Bureau of Entomology.

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except the western cotton-producing counties, which in recent years have contributed increasingly to the crop of the State. Practically all of the State of Louisiana is within the infested territory. In Mississippi, 23 counties are more or less infested; in Arkansas, 20; and in Oklahoma, 15. Of the total cotton acreage in the States concerned, the weevil is found in about 80 per cent in Texas, 30 per cent in Arkansas, 25 per cent in Mississippi, 35 per cent in Oklahoma, and practically 100 per cent in Louisiana. This area comprises very nearly 30 per cent of the cotton acreage in the United States in the year 1909, or about 37 per cent of the total number of square miles found within the cotton belt. In other words, a portion of the infested territory includes relatively a greater acreage devoted to cotton than the remainder of the belt.

It is important to note that along the extreme outer edge of the infested territory in the United States the weevils did not invade the cotton fields until late in the season of 1909; too late, in fact, to do any damage to the crop of that year.

The infested area includes many regions in which the boll weevil problem takes on local aspects. There is the greatest diversity of climatic and other conditions which react on the insect in such a way as to establish areas of varying degrees of damage. These individual areas will not, of course, display a constant amount of damage each season, but in a series of years will show features that serve to differentiate them from each other. In general, the damage is least on the dry plains of the western portion of Texas and increases toward the east. Where a large precipitation is combined with the presence of an abundance of timber, as in portions of Louisiana, the damage is greatest.

Nothing has transpired up to the present time to indicate that the weevil will not eventually reach the northernmost and easternmost portions of the cotton belt. Its advance to the east will be more rapid than to the north. This is on account of the lower temperature in the north, to which it seems necessary for the weevil to adapt itself more or less slowly. In some seasons the northward advance will probably be checked altogether by abnormal conditions, but the experience now acquired seems to indicate that the weevil will eventually overcome any climatic barriers that may be encountered. Although the advance to the east and north seems to be certain, there is a large region in the west into which the weevil can make its way only with very great difficulty, if at all. In the high, open plains of western Texas, where cotton production has developed enormously in the last ten years, the conditions of the winters and summers combined will probably serve as an effective barrier against the weevil. In that region there is little timber in which the insects may obtain shelter from the severe winters. Moreover, the normal dryness of the summer compared to that in more easterly regions, causing small plants and little shade, will act as an equally strong check upon the insect. On account of these conditions it can not be considered that the boll weevil is an important menace to the cultivation of cotton in the territory west of about the one-hundredth meridian.

FEATURES OF THE SEASON OF 1909.

The season of 1909 was very peculiar as regards damage by the boll weevil. The preceding season (1908) was also abnormal, but in quite a different way. The two abnormal seasons coming in succession have naturally given rise to various erroneous ideas about the future.

The situation in 1908 was affected first by climatic conditions of the fall of 1907 and the following winter. These allowed an unusually small number of weevils to pass through the winter. Experiments performed with many thousands of weevils in large field cages showed a survival of about 3 per cent as against 12 per cent after the winter preceding the season of 1907. That is, about four times as many weevils survived to damage the crop in 1907 as in 1908. The records based upon experimental cages were corroborated by the inspection of about 300 fields in June, 1908. From this work it was found that in the representative fields examined there was an average of only 3 weevils per acre in northern and eastern Texas in 1908 as against 226 per acre in 1907. In August, 1908, an examination of the degree of infestation of squares in many localities showed 5 per cent damage as against 54 per cent in 1907.

Following the remarkably disastrous conditions for the weevil in 1908 in Texas came another series of checks in 1909 in Texas in June, August, and September. This was the more important because the pest had not had sufficient time to recover from the loss suffered in 1908. It has been pointed out elsewhere that the most important check to the weevil in Texas is dry weather. It has been found that the damage done is practically in proportion to the amount of precipitation during the growing season. As the rainfall increases the damage becomes greater. The season of 1909 in Texas will always be notable on account of the extremely dry and hot weather. At Fort Worth there was a monthly deficiency in rainfall from February to June, inclusive, of over 1 inch. The accumulated deficiency for the first seven months in the year was 10.42 inches. It must be recalled that this represents practically a third of the normal total annual rainfall at Fort Worth. Other points in the portion of Texas where the bulk of the crop is produced show similar records. At Dallas, for instance, the accumulated deficiency of the year 1909 up to August 1 was 14.28 inches, for Waco 10.98 inches, for Palestine 13.03 inches, and for Taylor 11.28 inches. In addition to the actual shortage in rainfall very high temperatures occurred. The drought without the high temperatures, or vice versa, would not have affected the weevil especially. The two influences combined, however, served to give it such a check as it has never experienced in this country. At many points in Texas and Louisiana all records for summer temperature were exceeded. For several days the thermometer registered over 110° F. and in some cases 114° F. was reached. On the surface of the ground the temperature was naturally even higher.

No one who traveled in Texas during the season of 1909 could have failed to notice the effect of the abnormal climatic conditions on crops of all kinds. The cotton generally grew to from one-fourth to one-half of the normal size. The conditions were so adverse that even variety characteristics were more or less obliterated. The same conditions acted on the boll weevil. In fact, through large productive areas in central and northern Texas the insect was so reduced in numbers that it did not injure the crop to any extent whatever.

It is interesting to note that the experience of the season of 1909 shows conclusively that while a certain degree of dry weather is greatly to be desired for the controlling effect it has upon the boll weevil, dryness beyond a certain degree not only affects the boll weevil adversely, but also the cotton plant. In fact, it became evident that the cotton plant was so stunted by the dryness that it was unable to derive any advantage whatever from the comparative scarcity of the weevils.

DISPERSION OF 1909.

As regards dispersion, the season of 1909 was almost as unusual as in other respects. In one region by far the largest advance ever recorded was made by the weevil. This covered 120 miles of territory in southern Mississippi. At the same time in Oklahoma the greatest advance was only 30 miles, while throughout the greater portion of that State the line was extended only about 10 miles. A notable feature of the year's dispersion was the failure of the insect to extend its range considerably into the Yazoo Delta in Mississippi. During the preceding year an exceedingly light infestation reached the extreme southern portion of the delta. This was the vanguard of a flight that was rather extended. During the season of 1909 the insect extended its range in that quarter only about 15 miles. Why there should be an advance of 120 miles in southern Mississippi and only 15 in the northern portion of the State at first seems obscure, but studies that have been made indicate the explanation very clearly. One of the primary reasons for the dispersion movement of the weevil seems to be its inclination to obtain fresh food, and cotton squares in which to breed. Where the cotton fields are small and separated by considerable distances, this instinct causes the weevils to fly over a large extent of territory. On the other hand, where cotton fields are numerous it is unnecessary for a considerable advance to be made. In other words, a region of light cotton production causes the dispersion movement to be spread over more territory, while a region of heavy cotton production absorbs the weevils that are compelled to fly away from the locality in which they were produced. This undoubtedly explains in part the failure of the weevils to make a heavy advance into the Yazoo Delta during the season of 1909. Moreover, there is at least one further reason for the situation described. The number of weevils that enter into the dispersion movement must naturally be dependent upon the numbers that are bred in the cotton fields of the region from which the dispersion takes place. A heavy infestation in a certain region, therefore, means a large number of weevils to fly into previously uninfested territory. In a contrary way a light infestation means a comparatively small volume of weevils to fly beyond the original territory. In northeastern Louisiana, the locality from which the Yazoo Delta must naturally become infested, various conditions caused an unusually small number of weevils to be found in the fall of 1909. In fact, the number was not sufficient to cause a heavy dispersion movement. It is impossible to state which of these factors is more important, but in all probability the small number of weevils in northeastern Louisiana and the extensive cotton fields of the delta which absorbed the light movement were about equally important in preventing a further advance in the Yazoo Delta than was made in 1909.

HISTORY IN TEXAS.

Naturally the status of the boll weevil is shown by its history in the region in the United States where it has existed for the longest time. It is therefore important to examine the history of the insect in Texas. On account of great climatic variations, for the purpose of determining the manner in which the boll weevil has affected cotton production in Texas it is necessary to divide the State into three areas. These are eastern, central, and western Texas. The divisions are made in accordance with variations in normal annual precipitation and other factors. Eastern Texas as used in this circular is bounded on the west by a line running practically north and south from the western line of Lamar County to the western line of Brazoria County. In this region the rainfall is 45 inches per year or more. It comprises the counties listed below.[a] Practically the whole area is covered with forests. It covers 40,180 square miles. Central Texas comprises a broad belt from the Gulf to the Red River, beginning on the west with the limit of the belt of 32 inches normal annual rainfall, and extends eastward to the line just described as defining the

[a] Red River, Bowie, Franklin, Titus, Morris, Cass, Wood, Camp, Upshur, Marion, Harrison, Smith, Gregg, Cherokee, Rusk, Panola, Nacogdoches, Shelby, San Augustine, Sabine, Angelina, Trinity, San Jacinto, Polk, Tyler, Jasper, Newton, Liberty, Hardin, Orange, Jefferson, Chambers, Galveston, Lamar, Delta, Hopkins, Rains, Van Zandt, Henderson, Freestone, Anderson, Leon, Houston, Madison, Waller, Grimes, Walker, Montgomery, Harris, Fort Bend, and Brazoria.

western boundary of the eastern Texas area. Central Texas consists of 45 counties[a] and comprises 38,868 square miles. It is for the most part prairie country, although there are wooded valleys and occasional strips of timbered uplands. Western Texas comprises the remainder of Texas, beginning with the line marking the end of the area of 32 inches normal annual precipitation. It is largely a prairie region, though wooded valleys are numerous. Another factor in differentiating western Texas from central Texas is the increased elevation.

A careful study has been made of the manner in which the weevil has affected the production of cotton in the three regions mentioned. Use has been made of the census records of production from 1899 to 1909, a period of eleven years, as shown in the accompanying table:

Eastern, central, and western Texas cotton production compared, 1899–1909, from United States Census.

[500-pound bales.]

Years.	Eastern.		Central.		Western.[a]	
	Bales.	Per cent of Texas crop.	Bales.	Per cent of Texas crop.	Bales.	Per cent of Texas crop.
1899	637,872	22.44	1,633,618	62.61	337,528	12.94
1900	811,413	23.59	1,892,669	55.04	734,304	21.36
1901	633,620	25.32	1,448,872	57.90	419,674	16.77
1902	736,660	29.48	1,332,487	53.34	428,866	17.17
1903	545,288	22.06	1,242,654	50.28	683,139	27.64
Average, 1899–1903	672,970	24.88	1,510,060	55.85	520,702	19.26
1904	720,671	22.91	1,700,224	54.15	724,475	23.07
1905	329,523	12.96	1,414,115	55.63	798,294	31.40
1906	672,497	16.11	2,213,863	53.03	1,287,846	30.85
1907	343,328	14.92	1,218,143	52.95	738,708	32.11
1908	515,038	13.50	1,980,766	50.60	1,318,681	33.68
1909	474,311	18.80	1,362,096	53.99	686,404	27.20
Average, 1904–1909	509,228	16.53	1,648,201	53.39	925,735	29.72

[a] Including counties grouped by census under "All other."

In eastern Texas the production for five years ending with 1903 averaged 24 per cent of the total crop of Texas. During the same series of five years western Texas averaged 19 per cent of the total crop. For the six years ending with 1909 the eastern Texas production dropped to 16 per cent of the total crop of Texas, while the production in western Texas advanced to 29 per cent of the total crop in Texas. In other words, the portion of the Texas crop produced in one area has decreased 24 per cent and in the other it has increased 74 per cent. This increase in the west, where the dry climate reduces boll-weevil injury, served to offset the loss in eastern Texas, and

[a] Central Texas counties: Cooke, Grayson, Fannin, Denton, Collin, Hunt, Tarrant, Dallas, Rockwall, Kaufman, Johnson, Ellis, Bosque, Hill, Navarro, McLennan, Limestone, Bell, Falls, Williamson, Milam, Robertson, Brazos, Travis, Lee, Burleson, Washington, Hays, Bastrop, Caldwell, Fayette, Colorado, Austin, Guadalupe, Gonzales, Lavaca, Wharton, Dewitt, Goliad, Victoria, Jackson, Refugio, Calhoun, Matagorda, and Aransas.

thus accounts to a great extent for the fact that the total crop of the State has not fallen off.

The table is introduced to show in what manner the State of Texas is able to produce large crops of cotton since the advent of the weevil. There has clearly been a falling off in the proportion of the total crop of the State which east Texas produces. While this has happened an extensive immigration into western Texas, where the weevil is unable to withstand the climatic conditions, has resulted in a production which more than offsets the loss suffered in the eastern part of the State.

The great increase in production in the western portion of Texas is shown conspicuously by reference to individual counties. In 1899 Hall County, in the extreme western portion of the State, produced 113 bales; in 1908, over 17,000 bales. Between the same years the crop in Jones County increased from 4,000 bales to 33,000; in Taylor County, from 6,000 to 37,000; in Coleman County, from 8,000 to 62,000; and in Runnels County, from 3,000 to 56,000. There was an average annual gain in the period referred to in Hall County of over 10,000 bales; in Jones County, an average annual gain of over 22,000 bales. The other counties in that portion of the State show similar records.

While this remarkable increase has been accomplished in western Texas, there has been a great falling off in the eastern portion of the State. For instance, Fannin County produced 59,000 bales in 1899 and 48,000 bales in 1908. Likewise, in the same time Red River County fell from 29,000 bales to 18,000 bales. These conditions are better illustrated by comparing the average annual production before 1904 and since that year. This gives a period of ten years, in half of which the boll weevil was distributed generally in eastern Texas. For the five years ending with 1908, the crop of Fannin County showed an average annual loss of 16,752 bales; Lamar County, an average annual loss of 10,246 bales; Red River County, of 11,576 bales; and Grayson County, of 10,174 bales.[a]

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[a] The Bureau of Plant Industry attributes the reduction in cotton production in east Texas to the following causes, in addition to the boll weevil:

First. The construction of railroads and sawmills in the long-leaf pine counties, which, by their higher wage, drew their main supply of labor from the small farms of that section.

Second. The introduction of more profitable lines of agriculture, such as wrapper tobacco, truck gardening, small fruits, peaches and pears, for which east Texas is well adapted.

Third. The Texas coast rice industry, which in the past decade increased over 2,000 per cent and attracted many small farmers from east Texas.

Fourth. The general effort made by the United States Department of Agriculture to induce the farmers to raise their home supplies, which has had considerable effect.

This readjustment of agriculture in east Texas by a reduction of the acreage in cotton and the adding of other staple and cash crops would, however, have taken place in any event. It was simply hastened by the advent of the weevil.

Mr. F. W. Gist, of the Bureau of Statistics of this Department, has made a very careful study to determine the center of cotton production in Texas for each year from 1899 to 1908. As would be supposed from the figures that have been given, it was found by Mr. Gist that the center of production had moved considerably to the westward. In fact, this center moved from 30.78 miles east of the ninety-seventh meridian in 1899 to 19.14 miles west of this meridian in 1908. This was a westward movement of practically 50 miles. The center of production in 1899 was on a line passing north and south through the eastern portion of Grayson County, in Texas. In 1908 the center had moved to a line passing parallel with the other through the western portion of Cooke County, in Texas.

The situation in central Texas is most interesting. This area in the five-year period ending with 1903 produced 55 per cent of the Texas crop. For the six-year period ending with 1909 it produced 53 per cent of the Texas crop. This shows that for practical purposes the production in the central portion of the State has been maintained in spite of the weevil. This has been very largely due to the efforts that have been put forth by the Department of Agriculture, and indicates that in central Texas the control of the weevil for practical purposes is an accomplished fact.

In this connection attention may be directed to the fact that there is a tendency to attribute to the boll weevil more damage than is rightly chargeable to the insect. Climatic conditions, changes in acreage, and other factors, including the work of the bollworm and leaf worm, caused great variations in production in any locality, from year to year, before the advent of the boll weevil. Careful allowance must be made for the effects of such factors in determining the extent to which the boll weevil has affected the crop. In the statements made in this paper a careful attempt has been made to avoid overestimating the effect on the crop due to the boll weevil.

THE CHAIN CULTIVATOR.

Though not perhaps strictly connected with the status of the weevil, the opportunity is taken to discuss briefly an important machine for use in weevil control. As the result of many examinations to determine the natural mortality of weevils in cotton fields, it was found that when infested squares fell to the middles, where they were exposed to the unobstructed rays of the sun, the great majority of the weevils perished in a remarkably short time. Under natural conditions the bulk of the squares fall in the shade of the plants. Therefore attempts were at once made to devise a machine that would carry the infested squares from shaded areas to the middles, where they would be exposed to the sun. After a great deal of study and experimentation Dr. W. E. Hinds, now professor of entomology in the Alabama Polytechnic College, perfected a device that has been found to accomplish this work in a very satisfactory manner. It consists of two series of chains arranged on a wheelless carriage in such a way that the anterior ends pass close to the base of the plants, while the opposite extremities pass about midway between the rows. The inner posterior ends of the chains approach within about 8 inches of each other. As this machine is pulled through the field the great majority of the squares are dragged to the middles and deposited in a narrow row. In addition to the work of placing the squares where they will be acted upon by the sun, the chain cultivator has been found to have an exceedingly important cultural effect. It destroys small weeds, reduces clods, and fills the cracks. In fact, it establishes a dust mulch, which is greatly to be desired in cotton culture.

An experiment performed in 1908 showed the effects of the practical use of this machine. Half of a small field was cultivated in part by the chain cultivator and the remainder in the usual manner. The yield was increased by 131 pounds of seed cotton per acre where the machine was used. This amounted to a gain per acre of $3.93, or practically what the machine can be manufactured for. No extra labor was involved in the use of the machine, since its use merely replaced the use of the ordinary implements for the later workings of the crop. This experiment shows in a practical way the usefulness of the machine, which should eventually come into common use as much for its cultural effect as for weevil control. It is the direct result of strictly investigational work. The inventor of this machine surrendered all his rights as to royalties to the Department of Agriculture, so that its manufacture may be taken up by any individual or company without the payment of fees to anyone whatever.

The possible wide usefulness of the chain cultivator was appreciated by one of the largest implement concerns of the United States, which undertook the manufacture of 100 of them to be distributed during the season of 1909. Several practical tests were made during that season, and they showed that the hopes for the implement were not too high. Many planters who have witnessed the operation of the implement are arranging to use it for corn as well as for cotton.

PARASITES OF THE WEEVIL.

The insect enemies of the weevil are practically dependent upon it for food. Therefore any conditions that affect the weevil adversely over a large extent of territory also affect the parasites. On this account work of the insect enemies of the boll weevil in 1909 was not at all conspicuous. Nevertheless important advances were made in the studies of the practical utilization of these enemies of the weevil. One parasite that has attacked the weevil in Texas may have extended its range to the Mississippi River, and another, hitherto apparently restricted to the eastern portion of Louisiana, has been found in Texas. There can be no absolute certainty that these species have actually extended their range, but at any rate they were found over unexpectedly large areas. The fact that they do not appear to be as restricted to certain regions as seemed at first to be the case undoubtedly serves to increase their potential importance as enemies of the boll weevil.

In spite of the most unfavorable conditions the parasites caused a considerable weevil mortality. The average total control of the boll weevil by its insect enemies throughout the season of 1909 was 16 per cent. This total is smaller than in preceding years, but this is clearly due to the adverse conditions in the infested areas that have been described. It is very noticeable that the work of the parasites in hanging squares was considerable. It ranged in Texas from 46 to 54 per cent. That is, nearly half of the weevil stages found in hanging squares were destroyed by natural enemies.

The work of the year added several species to the list of known insect enemies of the boll weevil. The list now includes 49 forms, of which 26 are parasites in the true sense—that is, dependent upon the boll weevil for furnishing food for their young, because their eggs are deposited upon the weevil—and 23 are predatory species, which merely devour the boll weevil but do not deposit their eggs upon or in it.

IMPORTANT ADVANCE IN THE CONTROL OF THE BOLL WEEVIL.

During the season of 1909 a noteworthy advance was made in the control of the boll weevil by means of a poison. The credit for this achievement belongs to Mr. Wilmon Newell, of the State Crop Pest Commission of Louisiana. In experiments with Paris green for the destruction of the boll weevil, carried on in previous seasons, it was found that a certain number of the insects was killed. It occurred to Mr. Newell that the number reached by the poison could be increased greatly if a substance much finer than Paris green could be obtained. Arsenate of lead was the poison that was selected. Very large quantities of arsenate of lead may be applied to growing plants without any injury whatever. In the use of Paris green the presence of a small amount of free arsenic causes considerable damage to cotton plants if it is applied at the rate of as little as 5 pounds per acre. Mr. Newell succeeded in having an entirely new form of arsenate of lead made by one of the manufacturers of insecticides. The substance is an exceedingly fine powder that can be forced into the "buds" and even into the covering of the squares of the cotton plant to a far greater extent than a comparatively coarse powder like Paris green. The preparation of this form of arsenate of lead consequently obviated two important difficulties that attended the use of Paris green; that is, the danger of burning the plants by large applications and the difficulty in forcing the substance into the parts of the plants where it would be taken up by the insect. Thus the foundation was laid for very greatly increasing the mortality that had previously been obtained from the use of another poison.

In 1909 the State Crop Pest Commission of Louisiana had thirteen experiments with powdered arsenate of lead, located at different places, comprising over 46 acres. The poison was applied at from 1 pound to 51 pounds per acre. In different experiments from one to ten applications were made. In all but one of these experiments an increased crop was obtained that resulted in a profit, after deducting the expense incurred, which varied from a few cents to $23 per acre. In the one experiment which did not result in a net profit an increased yield of 121 pounds of seed cotton per acre was obtained. The very large amount of poison used in this case (51 pounds per acre) involved such an expense that this increased yield was not sufficient to offset it. In the experiments in which from 10 to 23 pounds of the poison per acre were used in from five to seven applications, the net profit ran from $3.63 to $23.54 per acre. The most profitable amount of the poison to be used seems thus to be indicated, although the conclusions from the preliminary work may be changed as the result of future investigations.

It is important to note that the very encouraging results obtained by Mr. Newell were in experiments in which the application of the poison was made either by one of his representatives or under this representative's directions. A large part of the efficiency of powdered arsenate of lead seems to be due to the thoroughness of the application. It is therefore to be supposed that under the practical conditions obtaining on plantations it may not be possible to obtain as successful results as those in some of the experiments described.

It does not detract from the high value of Mr. Newell's discovery to state that all the experiments that have been performed indicate most clearly that powdered arsenate of lead is not an absolute specific for the weevil in the sense that it can be relied upon to the omission or neglect of other means of control. The early fall destruction of the cotton plants is undoubtedly a condition necessary to the successful use of the poison. Likewise, the other steps in the system of control advocated by the Bureau of Entomology are not minimized by the importance of the present discovery. At most the poison merely places another means of control at the command of the planter. Everything indicates that it will be an important means. The system of control in use has been to a certain extent a combination of expedients for avoiding damage rather than of ways of actually killing the weevils. In fact, the early fall destruction of the weevils by burning the plants has been the only important and generally applicable direct means at the command of the planter. Powdered arsenate of lead is especially important as a direct means of killing weevils that may be applied at a season in which hitherto no important means of a direct nature have been available. Extensive work that is now being planned it is hoped will lead to definite recommendations as to the procedure to be followed in the use of the poison for the greatest possible profit under various conditions.

The most important difficulty that is likely to be encountered in the use of powdered arsenate of lead against the boll weevil is the possible deleterious effect of the poison in the soil. Recent investigations conducted in orchards in Colorado where spraying of arsenicals has been practiced for many years seem to indicate that a considerable amount of damage has resulted from the arsenic that has become lodged in the soil near the bases of the trees. In fact, Prof. W. P. Headden believes that in addition to the caustic effect of the arsenic on the roots of the trees there is a probability that damage is done the plants by absorption. At any rate, cases have been observed where the general health of the trees seems to have been affected in such a manner as would only seem likely to result from absorption. Although this matter is by no means fully understood at this time, it will be necessary to investigate carefully the possibility of injurious effects on cotton lands from repeated annual applications of such large quantities of powdered arsenate of lead as were found to be profitable in the experimental work in controlling the boll weevil. If the cumulative effect of these applications is at all considerable, the use of the poison can not be advised. At the same time there is a possibility that something may be done in the counteracting of the possible deleterious effects of arsenate of lead by the application of some material with the fertilizers.

Approved:

James Wilson,

Secretary of Agriculture.

Washington, D. C., *April 1, 1910.*

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