REPORT OF THE ENTOMOLOGIST.

INTRODUCTORY.

SIR: I have the honor to present herewith my annual report as Entomologist for the calendar year 1890.

A summary of the work of the Division for the year has been presented in your annual report to the President, and is reprinted in the opening pages of this volume. The subject, therefore, needs no elaboration here. The articles which follow are short and condensed accounts of some of the more interesting observations and experiments of the year.

That upon the boll worm investigation is merely a report of progress and a discussion of plans. The army worm has made two destructive appearances during the year, one in Maryland and the other in Indiana, and as these appearances have an interesting bearing upon the subject of influence of climate I have devoted some little space to their consideration. Following this article I have brought together some notes upon the bronzy cut-worm, an insect which is often taken for the army worm, and the consideration of which is additionally appropriate at this time for the reason that it is commonly affected with a bacterial disease which may possibly be transmitted to the boll worm. Some observations and remedial experiments upon the horn fly of cattle are brought together as supplementary to the details in my last annual report. Four new species of the genus Icerya, recently described in INSECT LIFE, are referred to, because of their close relation to the fluted scale of California, and of the economic interest attaching to the species of the genus. Considerable work has been done in California during the past year upon the question of remedies for the scale-insects other than the fluted scale. The results of these experiments upon the so-called black scale (*Lecanium oleæ*) are given in this report and some interesting experiments upon the red scale (*Aonidia aurantii*) are mentioned in the summary of the reports of agents. Concerning this species two distinct forms have long since been known and these are considered in detail and their differences set forth. The green-striped maple-worm is an insect which has been frequently brought to the attention of the Division of late years, and in order to make its life history and the remedies against it more generally known, I have included a short account. The rose chafer (*Macrodactylus subspinosus*) has also been very prominent of late and is also treated herewith. Another insect which may possibly soon gain economic importance in this country is considered in the article headed "A New Peach Worm," while the work of the field agents of the Divi-

sion during the season is summarized in a concluding article, the full text of their reports being reserved for a bulletin.

It were premature to refer in detail to a number of minor investigations which are in progress, but I may mention the fact that I have made during the year an attempt towards repaying the people of Australia and New Zealand in some degree for their assistance in the introduction of *Vedalia cardinalis* into California, by sending them predaceous and parasitic species which may help to reduce the numbers of the codling moth, an insect which is, perhaps, more destructive in those countries than in any other part of the world. Among the insect enemies of the codling moth recently discovered by Mr. Koebele, in California, is a Neuropteron of the genus Raphidia, the larva of which is very active and rapacious and feeds extensively upon the apple worm after these have issued from the apples. A shipment consigned to Mr. R. Allan Wight, of Auckland, arrived in fairly good condition, seventeen being alive, sixteen in the pupa state, and one in the larva state. The latter fed voraciously upon the first apple worms which were offered to it. The latest advices are somewhat discouraging, as there is no certainty that the insect has survived and been colonized there. I have also made efforts to introduce some of the European parasites of the Hessian fly which do not yet occur in the United States.

That these efforts have not been successful is largely due to the fact that they had to be made through correspondence. The clause restricting travel to the United States is still maintained in the appropriations for the Division, and this seems very strange in face of the example of *Vedalia*, the successful importation of which has been worth many millions of dollars to the people of California, but which could not well have been made without sending an agent to Australia. I again urgently recommend that steps be taken to have this unnecessary restriction removed.

An interesting event of the year is the appearance of the hop fly (*Phorodon humuli*) upon the Pacific coast. This insect has up to the present season been known to occur only in Europe and in the hop fields of the United States east of the Mississippi river.

The correspondence of the Division has been rather larger than last year and about three thousand eight hundred letters have been written to correspondents in answer to inquiries and a large number of others have been answered by circular. The collections have been greatly added to by donations, purchases, and exchanges, and the amount of Museum work in the way of the determination of species, not only for investigators in all parts of the country, but for the agents of the Division and the entomologists of experiment stations, has greatly increased. As stated in my last report, this branch of the work of the Division is growing more and more onerous, and while it is extremely important, its results are shown in the reports published by those thus assisted rather than in any visible output of the Division.

The report has been kept within the limit as to length allotted to the Division. I greatly miss the opportunity of publishing extended articles upon important insects afforded in previous annual reports, but which present exigencies forbid. The insufficiency of the printing appropriation at the disposal of the Department will also not permit of the publication of as many or as long bulletins of the regular series of the Division, or of special reports, as the accumulation of information in the Division demands.

Congress has appropriated $27,500 for the use of the Division during the fiscal year 1890-'91, an increase of $7,500 over the preceding year's appropriation, and while the opportunities for investigation are increased, the no less important opportunities for placing the results of such investigations before the public are in reality lessened. The Division is in urgent need of additional facilities for publication, and also of additional facilities for office and experimental work.

A detailed list of the publications of the Division during the year will doubtless be published in the report of the Division of Records and Editing, and will, therefore, be unnecessary here, but I may state that these publications have occupied more of the time of the office force than usual. INSECT LIFE, the periodical bulletin, has been issued about once a month, and most encouraging comments concerning the usefulness of this publication are constantly being received.

Bulletin 21 of the Division was published early in the year, and is an account of the trip of one of the California agents to Australia to collect and import the parasite of the fluted scale. Incidentally some account of other injurious Australian insects is given.

Bulletin 22 contains the reports of the agents in California, Iowa, Indiana, Missouri, and Nebraska upon their observations during the year 1889, and includes particularly a discussion of the insects injurious to young tree claims in Nebraska and an important article on the insects injurious to pastures and meadows in Iowa.

The first three parts of the Bibliography of the More Important Contributions to American Economic Entomology, with index, making a volume of 450 pages, was published early in the year, and the small edition has already become exhausted.

In the regular series of bulletins of the Division, number 7 has been held open for a short review of the species of the genus Acronycta, the larvæ of which are destructive leaf eaters; but for numerous reasons it has been impossible to complete this paper, and rather than delay the binding of the set I have filled this number by submitting for publication that portion of the report affecting live stock and other animals which treats of the Mallophaga. I have also ready for publication a popular bulletin on locust ravages, which will be printed as number 23, and also Bulletin 24, which will comprise the reports of the agents of the Division for the season of 1890.

It was announced a year ago that Dr. Packard's report on forest tree insects, being the fifth and final report of the U. S. Entomological Commission, was going through the press. The final proofs were read about the 1st of October, but owing to a press of executive work the printer has not been able to run off the edition. It is a large report of nearly 1,000 pages, and is very fully illustrated.

Respectfully submitted.

C. V. RILEY,
Entomologist.

Hon. J. M. RUSK,
Secretary.

THE BOLL WORM INVESTIGATION.

In the fourth report of the U. S. Entomological Commission, which was devoted to the consideration of the cotton worm (*Aletia xylina* Say) and the boll worm (*Heliothis armigera* Hübn.), we dwelt upon the fact that in many parts of the South the damage done by the boll worm to the cotton crop exceeded that done by the cotton worm; and when we consider that the former insect is not, like the latter, confined to this one crop, but damages other staples, such as corn, pease, beans, tomatoes, and tobacco, *Heliothis* may be safely classed as one of the foremost of the so-called first-class injurious insects. In our consideration of its injuries to cotton in the report just mentioned, we gave a complete account, so far as it was possible at that time, of the characters, transformations, number of broods, method of hibernation, natural enemies, food plants, and remedies, together with summaries of less important points, such as nomenclature and geographical distribution, and concluded with a partial bibliography.

Since the publication of this report. in 1885, there has been no year when the injuries of the cotton worm, compared. for instance, with those of 1868 and 1873,—a result in no small measure due to the effective remedies discovered. But damage from the boll worm seems to have been on the increase. The edition of 30,000 copies of said fourth report was exhausted with the close of 1889, while during that year the requests for additional information were larger than ever before. During the winter of 1889–'90 Congressional influence was brought to bear for a further investigation of the boll worm, and strong letters were received from Hon. Richard Coke, U. S. Senator from Texas, and the Hon. N. C. Blanchard, member of Congress from the fourth district of Louisiana. The former was accompanied by letters from the director of the State Agricultural Experiment Station and from the mayor of Brownsville and the superintendent of the State penitentiaries, and the latter conveyed a memorial, signed by the president of the Shreveport Cotton Exchange and by the president of the Board of Trade of the same city. Both Senator Coke and Mr. Blanchard urged that a supplementary investigation be undertaken by the Department, and in view of the fact that the investigations for the present fiscal year had already been planned at the time when this matter was brought up, Senator Coke introduced an amendment to the agricultural appropriation bill in the Senate appropriating $2,500 for this purpose, which has passed and became a law July 15.

The season was so far advanced at the time when this appropriation became available that the best results which should be brought about by such a supplementary investigation were to some extent impaired. Steps were, however, at once taken to start the work for the remainder of the season, so that everything will be in readiness for more perfect work in 1891.

Before the necessary agents could be appointed and sent to the field the top crop of cotton, which is always the portion of the crop which is most damaged by this insect, had already been picked in the southern portions of the cotton belt. There was, therefore, little to be gained in sending men to what is perhaps the worst infested section, viz, the State of Texas south of the Brazos Valley. We learned from correspondence with Prof. George W. Curtis, the

director of the Agricultural Experiment Station at College Station, Texas, that he had already begun an independent investigation on the boll worm and that he would be glad to coöperate with the Department in our investigation of the same subject. With the object of assisting Professor Curtis in his investigation, we sent Mr. Nathan Banks to College Station early in August. He remained with Professor Curtis until the 1st of October, assisting him as much as possible in his work and reporting both to him and to this Division.

Prof. Jerome McNeill was also temporarily stationed at Pine Bluff, Arkansas, to conduct investigations at that point.

One of the principal features of the Hon. Mr. Blanchard's letter and the memorials from the Stock Exchange and the Board of Trade of Shreveport, contemplated the investigation of the fungus and bacterial diseases of certain caterpillars with the idea of endeavoring to convey such disease to the boll worm and also the cotton worm. As we found after investigation that Dr. A. R. Booth, of Shreveport, Louisiana, was well fitted for conducting this phase of the investigation he was entrusted with this work at that point.

Meanwhile Mr. F. W. Mally was sent first to Arkansas for consultation with Professor McNeill, afterwards to Shreveport for conference with Dr. Booth, and after surveying the ground and endeavoring to ascertain the most advantageous point for work at that time of the year he was stationed at Holly Springs, Mississippi, for the remainder of the season, where he has been making observations upon the natural history of the species and conducting experiments with remedies. Dr. Booth has already established the susceptibility through contact of the boll worm to the cabbage worm disease (*Micrococcus pieridis*), and has a very large number of cultures which we shall endeavor to carry through the winter.

Other diseases of Lepidopterous larvæ have also been experimented with, notably the one or more which commonly affect the bronzy cut-worm (*Nephelodes violans*). These diseases seem well worthy of experimentation on account of the swiftness and thoroughness of their work, and we have had our Indiana agent, Mr. Webster, collect and send a large number of these diseased cut-worms to Dr. Booth, who has successfully made cultures of the disease germ for experimentation next spring.

Professor McNeill was stationed during the latter part of the season at Pine Bluff, Arkansas, and has done some original work in the matter of remedies. It will be premature at this time to mention by name any of the mixtures with which he has been experimenting. We hope, however, when their efficacy or non-efficacy has been thoroughly established, to be able to publish results which will have considerable value as additions to our knowledge of remedies.

Mr. Mally has covered a good deal of ground in the character of his work and has discovered certain new facts concerning the habits of the larva and imago, and has found a bacterial disease of the larva, another probable disease of the moth, and also a disease of the eggs. He has reared six true insect parasites and has found a few others which are possibly parasitic upon this insect. He has found other new food-plants of the boll worm and has studied the habits of other insects feeding upon cotton bolls, the work of which is easily confounded with that of Heliothis.

THE ARMY WORM.

Two rather interesting occurrences of this well-known insect have been reported to the Department during the summer of 1890. In May we learned from the local newspapers and through the Maryland Agricultural Experiment Station of the occurrence of the worms in great numbers in Somerset and Wicomico counties, Maryland, and sent Mr. W. H. Ashmead to report upon the state of affairs. Mr. Ashmead was accompanied by Mr. Hayward, the horticulturist of the Maryland Agricultural Experiment Station, and his report is published in full in INSECT LIFE, Vol. III, No. 2, pages 53 to 57. So far as he could learn the reports of the occurrence of the worm in Wicomico County were without foundation. In Somerset County, however, he found that great damage had been done to fields of wheat, corn, and timothy. The belt of country overrun by the worms included the town of Princess Anne and extended over a radius of from 10 to 15 miles.

The usual ditching remedies were tried with a greater or less degree of success, but the outbreak would be hardly worthy of more than passing mention were it not for the fact that the character of the preceding year seems to have been different from those which we have, from past experience, been led to consider as necessarily connected with the appearance of these worms.

In the third report of the U. S. Entomological Commission, where we have given very full treatment of this insect, we have summarized our views on the subject of the reasons for the sudden appearance and disappearance of this species. We discussed previous theories, particularly those of Dr. Asa Fitch and Dr. Cyrus Thomas, and made the general statement that from an examination of the weather records the years immediately preceding Army Worm years have been nearly universally characterized by drought, while the seasons in which the worms actually appeared have been either wet or dry. From this knowledge we are unable to say with certainty, as thought by Dr. Thomas, that after one or two seasons of drought the army worm will appear. From the observed facts during the winter and early spring of a given season, however, we may form pretty accurate conclusions as to the abundance of the worms the ensuing summer, and this is especially true when the preceding summer and autumn have been exceptionally dry.

Now the interest attaching to this Somerset County incursion arises from the fact that the summer and autum of 1889 in this part of the country were considered wet. General Greely has kindly furnished the Department with a table of annual precipitation for the years 1888, 1889, and 1890 for the State of Maryland, and, although only one of the stations (Barren Creek Springs) is situated sufficiently close to the infested belt to render its reports of any value in this connection, it is evident from this station's records that the season of 1889 was extremely wet during the months of March, April, May, June, excessively so during July, rather dry during August, with about the average rainfall in September, and wet again during October and November. This station is 15 miles to the north of Princess Anne and substantially the same rainfall is to be predicted. We have, however, used the private records of one or two planters whose crops suffered, Messrs. William J. Porter, James N. Dennis, and H. H. Deshields. They have characterized the spring and fall

of 1889 as very wet. Messrs. Porter and Deshields state that the summer was also very wet while Mr. Dennis characterizes it as dry. The general conclusions which we have drawn in the report already referred to were fully substantiated for the Atlantic seaboard as a whole. The Maryland occurrence was local, and, could all the facts be ascertained we should doubtless find some explanation not at variance with previous experience.

We have, however, brought out another point in our previous writings not touched upon by others, and that is the character of the preceding winter.

In an article published in May, 1883, we showed that the previous winter had been open and that worms of all sizes had been found during the winter in the vicinity of Washington and various parts of the South. We drew the inference that damage might be expected late in the spring, particularly if the weather proved in any way wet. It is true that the summer of 1882 was one of considerable drought, but this was hardly taken into consideration in this prediction. The result was that for the first time in many years the army worm did considerable damage in the vicinity of Washington and great harm to the grain fields of northern Alabama, Georgia, and Arkansas.

To apply this to the outbreak under consideration: During the past winter the weather was remarkably open, and the season was universally characterized as mild and wet. Mr. Deshields states that it was the mildest winter ever known to the oldest citizen. The worms hibernated in numbers and Mr. Ashmead states in his report that "all the farmers and others interviewed concurred in the opinion that the winter of 1889–'90 had been unusually mild and dry, and a few reported having observed the worms feeding on warm days during the winter."

We must, then, conclude that a preceding drought is not so essential a precursor of destruction by this insect as it has hitherto been considered to be, but that injury may depend, at least in this latitude and further South, on very open winters during which the larvæ will remain active and feed and when there may possibly be an opportunity for an additional generation, or at least for an unusally early development of the moths from the hibernating larvæ.

The second occurrence of the worm took place in May in Posey County, Indiana, and was investigated by Mr. Webster, whose brief report is published in No. 3, Vol. III, of INSECT LIFE, pages 112 and 113. The overrunning of only 150 acres is mentioned by Mr. Webster, but this instance possesses considerable interest from the fact that this strip (of timothy) and the adjacent cultivated lands were situated on the second bottom of the Ohio River and were all overflowed during March, the overflow remaining long enough to destroy the young wheat. Young worms were noticed in great numbers in the 150-acre meadow on May 2, and by June 7 had entirely destroyed the timothy crop and had entered the ground to pupate.

It seems to us that this appearance can only be explained on the ground of a superior growth of the crop of timothy brought about by the overflow. Moths issuing from hibernating larvæ early in May must have been attracted by the rank growth of this meadow and must have therefore oviposited in the grass abundantly.

Other points, such as the vicinity of fodder stacks, doubtless had considerable bearing upon this occurrence, but these were not investigated.

Mr. Webster noticed an extraordinary abundance of parasites in

the Indiana meadow, principally Tachina flies, while in Maryland these seemed to have been scarce. Mr. Ashmead found the common Microgaster (*Apanteles militaris* Walsh) in small numbers, but observed many ground beetles preying upon the worms. Among these he mentions *Scarites subterraneus*, which has not been previously recorded as an enemy of the worm. He also states that the English Sparrow was observed picking out the smaller worms and feeding on them, and a few robins were engaged in the same work. He also mentions a rather curious fact in that the stench from the dead worms which had collected in the ditches was so great as to attract buzzards.

THE BRONZY CUT-WORM.

(Larva of *Nephelodes violans*.)

[Plate III, Fig. 3.]

An insect which is frequently mistaken for the Army Worm, and which has several times been sent to us by correspondents with the question as to whether it was not the well-known depredator which we have just been considering, is the large handsome caterpillar which we have called the bronzy cut-worm. A brief account of it is further appropriate here because of its being subject to an epidemic bacterial disease which may possibly be employed against the boll worm. As long ago as April, 1871, we found this insect feeding in numbers upon clover on the Iron Mountain road in Missouri and later in the same season found it upon blue-grass in other parts of the State.

In October of the same year we found it at Ithaca, New York, and again in the spring of 1872 found large numbers in the vicinity of St. Louis and reared the moth. Since then it has been sent or brought to us on a number of different occasions and we have fully studied its life history and reared from it several parasites.

In the meantime, however, it has been thoroughly written up by Dr. Lintner, the State Entomologist of New York, in his first annual report, Albany, 1882, pages 99 to 110, in which use is made of some of our manuscript notes sent him for the purpose. In his fourth report, Albany, 1888, pages 54 to 57, he gives an interesting account of the winter occurrence of this caterpillar, and shorter notes have been published by other entomologists, mainly, however, of the occurrence of the moth in different parts of the country. It will suffice for our purpose here to give a brief account of the life history of the insect which may be readily recognized in its different stages from the accompanying figures (Plate III, Fig. 3,) engraved in 1880.

The moths, Fig. 3*c*, make their appearance during the months of August and September, the females laying eggs so that the resultant larvæ will have time to feed and pass through two or more molts before winter. The eggs have not yet been specifically observed, and we know nothing yet of the exact mode and place of oviposition. The partly grown worms hibernate under sticks, stones, and other rubbish, and upon the opening of spring come forth and feed upon grass and other low-growing plants until they reach full growth. The time when they enter the ground to pupate varies from the first of June to the end of the same month, and they remain in the ground some time before transforming and issue as moths, as just stated, from the first of August on.

While they feed in the hot sun at midday this is chiefly the case with diseased worms, as normally they are essentially nocturnal. In the more southern States the species may hibernate as a moth as it is frequently captured in the winter. The very young larvæ are bright green with bare indications of the stripes which characterize the large ones. The full-grown larva is one of the largest of its family, and is distinguished from all others by the pale amber-colored head and the bronzy hue of the body, the pale dorsal and subdorsal stripes always showing distinctly on the dark highly polished cervical and anal plates. In July, 1881, we gave some account* of the alarm created in New York and other Eastern cities by the appearance of this insect in some numbers, and there published a description by which it may readily be distinguished from the army worm. This description we reproduce.

NEPHELODES VIOLANS.—*Larva:* Larger specimens fully 1.9 inches long, largest in middle of body and tapering slightly each way, especially toward anus. Color brownish bronze, the surface faintly corrugulate, but polished, the piliferous spots obsolete. A darker, highly-polished cervical shield and anal plate. A medio-dorsal and subdorsal stripe of a buff or dull flesh color; each stripe of about equal diameter (nearly .04 inch on middle joints), forming narrower, paler lines on the plates and nearly converging on the anal plate; a similar but somewhat broader substigmatal stripe, which is wavy below; between subdorsal and stigmatal stripes a faintly indicated pale line dividing the space nearly equally. Venter nearly of same buff color, with a tinge of green. *Head* perpendicular, immaculate, paler than body, rugulose, subpolished, faintly translucent, pale dingy olive, the jaws, and sometimes the mouth parts, darker. Legs and prolegs of same pale olive color, the latter with a black band at outer base. Stigmata black.

The young larva is green, but early shows the pale stripes. When about one third grown the general hue is olive-green, with the cervical and anal plates but little darker. The head is pale, greenish, faintly freckled, and with a few dark hairs; the sutures pale, the mandibles tinged with blood-red and brown at extremities, and the ocelli distinct on a pale ground, the second and third from below black, the others light. The three dorsal stripes and the narrower suprastigmatal line are very pale, greenish yellow, the broader substigmatal stripe of a clearer cream yellow, with a faint carneous tint.

One of the most marked Noctuid larvæ, at once distinguished from all others known to me when full grown by the pale, immaculate head (recalling copal), and the polished bronzy or umber color of body. The upper stripes are often obsolete or subobsolete in the middle of body, but are persistent on the plates. The bronzy color in paler specimens is due to brown and yellow mottlings, and in dark specimens becomes nearly black, while the stripes are generally minutely mottled with carneous.

Pupa: Normal, dark brown, the tip with two horizontal almost parallel spines.

The bronzy cut-worm is quite subject to the attacks of natural enemies. Professor Forbes has shown that it is often found in the stomach of the bluebird, robin, and red-winged blackbird. We have reared from the larva in Missouri two Hymenopterous parasites and a Tachinid fly. The Hymenoptera are both Braconids and belong to the same genus. They are *Rhogas rileyi* Cresson, and *Rhogas terminalis* Cresson. The first of these we have figured at Plate IV, Fig. 1. Much more effective, however, than the predatory or parasitic enemies of this insect is the bacterial disease previously referred to. This is a Micrococcus which Professor Forbes has for some time been studying, but which is not yet named. We have been familiar with it for many years, but we believe that public attention was first called to it by Professor Osborn in June, 1881. He then stated that the diseased worms would be found clinging to the stems as high up as they could reach, their bodies swollen to an unnatural size, and in the later stages exceedingly soft and ready to fall to pieces. This

* Amer. Nat., July, 1881, pp. 574–577.

disease has been noticed by us almost every year since, but was particularly prevalent in the summer of 1887, when on a trip through Indiana and Ohio and to the East it was everywhere noticed. It was an extremely difficult, not to say impossible thing, in fact, to find a single healthy worm. The hiding-by-day instinct seems entirely absent with the sick worms, which crawl laboriously up the stalks of grass and there station themselves, as described by Professor Osborn, to die and eventually to shrivel up into unrecognizable objects.

The bronzy cut-worm is also attacked by a fungus disease which was noticed by Mr. Webster in our annual report for 1886, page 579, where, in treating of the glassy cut-worm (*Hadena devastatrix*), he makes use of the following language:

Dead larvæ were found in the earth, stretched at nearly full length, rigid, and with a parasitic fungus, a species of *Isaria*, growing from between the thoracic segments, but more frequently from the neck, after the manner of *Torrubia* from the white grub, only that in this case they affect the upper as well as the under part. This was also observed to attack the larvæ of *Nephelodes violans*.

ADDITIONAL NOTES ON THE HORN FLY.

(*Hæmatobia serrata.*)

Complaints about the horn fly have been fewer during the past summer than during that of 1889. Mr. H. M. Magruder, of Charlottesville, Virginia, wrote us, May 12, that the fly had made its appearance again in considerable numbers and was annoying cattle greatly, and one or two other complaints were received from the same neighborhood. In the vicinity of Washington, however, and in several other localities where the fly was very abundant last season, they have this year been almost unnoticed. Mr. Magruder, in writing to us on the date above mentioned, and referring to the impracticability of the application of lime to the droppings in the very large fields in his part of the State, desired instruction as to applying a preventive by means of a force pump upon the comparatively wild cattle in the large pastures. September 4 he wrote us as follows:

About the 1st of June I made up an emulsion of kerosene according to the formula sent me, and putting it in my knapsack spraying pump with Vermorel nozzle used in spraying my vineyard, went among the cattle while they were licking salt, applying the fine spray to the patches of flies. They would abandon the animal at once on feeling the spray, some settling on others, but none returning. Next day the flies were much diminished in number. After three applications they were so diminished that I did not use the spray again for three weeks. Two more applications so thinned them that my cows and cattle have been almost free the rest of the summer. Whether owing to the spray or not I can't say, as later on they thinned out also on cattle of neighbors, who did not use anything; but it certainly looked as though the kerosene emulsion either sickened or killed them or caused them to seek other quarters. I am going to try it again when the flies get troublesome.

The experiment was not conclusive but indicates that this method of applying the oil mixture is practicable and will certainly warrant a thorough trial in case of future abundance of the flies. Two of the localities where the fly was very abundant during 1889 were at Calverton and The Plains, Fauquier County, Virginia. These two points are only 16 miles apart and the conditions seemed precisely the same at the time of our investigations. In October we wrote to Col. Robert Beverly, of The Plains, and Mr. G. M. Bastable, of Cal-

verton, asking them as to the abundance of the fly during 1890 at their respective locations. They answered as follows:

The horn fly appeared here this season about the 1st of May, and has been and is yet in great quantities, probably four times as many as last season, and has done great damage to our cows and cattle, reducing the quantity of milk and preventing the cattle from fattening and in some cases producing great sores upon them. I have an ox and three steers with patches of sores as large as your hand all over them made by these flies, and the cods of all the steers are sore from them. Where the cattle lie down the cods are black with them. I think the cattle in this county have been reduced 75 to 100 pounds from what would have been their best weight, and some cattle, favorites of them, have not fattened at all. You have not heard from us about them because we see or think there is no remedy. Their area is much extended. I saw them in force in Essex County, Virginia, and in Russell County, southwest Virginia. In neither section were they last season. The people from those sections wrote me about them. I replied there was no remedy that I knew of. I wish you could find a remedy. Possibly a very cold winter may reduce them. * * *—[Robert Beverly, The Plains, Virginia, October 10, 1890.

There has been very little complaint made by the farmers in this section. On all the cattle I have seen there has been quite a number of these flies, but nothing to compare with the number last year. In all my inquiries during the past summer none have considered the fly as a dangerous pest.—[G. M. Bastable, Calverton, Virginia, October 10, 1890.

In the article in the last Annual Report our generalizations concerning the life history of the horn fly were based upon records in the Divisional notebooks brought down to September 28, 1890. The manner in which the winter is passed had not then been determined and the matter of parasitic or probably parasitic and carnivorous insect enemies had not been discussed. The following account of the winter habit and of the insect enemies of the horn fly is given to supplement and complete the article referred to.

On the date last recorded, September 28, the flies were still as abundant as ever about Washington. From this time they decreased in numbers and practically disappeared about the middle of November. Observations made at this time in Virginia, near Rosslyn, did not result in the discovery of the Hæmatobias either about the cattle or in the stables. In one instance, which, however, was doubtful, as the insect was not captured, a supposed Hæmatobia was seen on an animal. The common stable fly (*Stomoxys calcitrans*), however, still occurred in numbers about cattle.

On December 13 a considerable quantity of dung was collected from a pasture on which cattle had not ranged for from three weeks to a month. The material contained puparia of various Diptera in considerable numbers, the puparia occurring either in the dung or immediately beneath it, and were not found in the soil below, except as the latter had been carried up and incorporated with the lower portions of the dung by the agency of angle worms. Many of the puparia were exposed on the surface, having been washed out by rains, but were in good condition.

In the dung examined two puparia of the horn fly (and proved by breeding to be such) were found, and also the larva of an Anthomyiid. Besides these were found two other species of Dipterous larvæ and the puparia of some eight species, most of which, together with other Diptera not separated as puparia from the dung, were subsequently reared.

Altogether over forty species of Diptera were reared from dung in the investigation of the horn fly. From the Hæmatobia puparia mentioned above the adults emerged January 2 and February 17. *Stomoxys calcitrans* was reared from this material January 20, and

from dung collected November 27 this species was educed May 7 and 14. The appearance in these breeding experiments of the Hæmatobias and Stomoxys was doubtless in advance of the normal period under natural conditions owing to the protection and warmth of the breeding house, but certainly indicates that the winter is passed, in the case of both these species and also with a host of other Diptera in puparia either in or just beneath dung in the open field.

The difficulty in finding the hibernating pupæ of the horn fly, especially in a locality where this insect was at no time excessively abundant, can be readily understood, and the discovery of the puparia under the conditions mentioned, together with the breeding in January and February of the adults, is sufficient evidence that the winter is normally passed in the pupa and not in the adult stage. Corroborative of this is the similar habit observed for other Diptera and particularly in the instance of the related *Stomoxys calcitrans* which, however, occurred much later in the fall, being noted in the fields as late as December 13.

February 28 Prof. John B. Smith wrote us from New Brunswick, New Jersey, as follows:

> As to Hæmatobia it hibernates as imago without any doubt, whenever it gets cold enough. They went into winter quarters for awhile and were found in stables and barns hidden away. They seem, however, to have reached the conclusion that they were mistaken in their estimate of the season and have taken to breeding again. Dr. Lockwood is breeding flies at Freehold from cow dung brought in from the fields. My correspondents from northern New Jersey inform me that larvæ are abundant in droppings, but that the flies do not seem to be plenty.

We wish that Professor Smith had given us details in confirmation of his statement that the insect "hibernates as imago without any doubt," for in our experience we were unable to prove any such condition of affairs, notwithstanding the fact that the Washington winter must be a trifle milder than that season in northern New Jersey. Dr. Lockwood's experience at Freehold coincides with our own, and we reared the flies even earlier than he did. The hibernation of the adult in this locality must be exceptional, while the hibernation of the insect in puparia is the rule not only with this but with other species of flies, some of which are popularly supposed to universally pass the winter as adults. For instance, it is the general impression that this is the case with the common house fly, but, while many individuals undoubtedly hibernate in houses as adults, we had personal evidence many years ago in Missouri of out-door hibernation in the puparium state.

PROBABLE PARASITIC INSECTS.

In the rearing of 1889–'90 someeight species of Hymenoptera were obtained from dung, several of them from puparia previously isolated, but for the most part they were obtained from the dung without its being possible to determine which, if any, of the Dipterous larvæ or pupæ they attacked. It is probable that little, if any, choice was exercised, and that the different Diptera were all more or less subject to attack. The species bred are the following:

Hemiteles townsendi Ashm. Four specimens.
Aphœreta muscœ Ashm. Very abundant.
Onychia sp. Very abundant.
Figitis (?) sp. Three specimens.
Hexaplasta sp. Very abundant.
Kleidotoma sp. Very abundant.
Diapria sp. One specimen.
Spalangia sp. One specimen.

The Onychia was frequently observed ovipositing in fresh dung apparently at random. *A. muscæ* was bred from puparia of Diptera, but with no positive evidence of its being reared from those of Hæmatobia. This species, however, was perhaps the most abundant of the parasites bred from the dung, and it is very likely that it will be ascertained to be a true horn fly parasite as well as a foe to other dung-feeding Diptera. We have figured it at Plate IV, Fig. 2.

Several species of beetles, *Staphylinidæ*, were observed to frequent the dung and to feed on the eggs of Diptera, particularly on the egg-masses of the common blue-bottle fly (*Lucilia cæsar*). The eggs of the latter were drawn out and quickly eaten or sucked and the empty shells discarded. These beetles were not observed to attack the larvæ.

CAUSE OF THE SEASON'S EXEMPTION.

The abundance of the horn fly during the summer of 1889 and its general scarcity during the summer of 1890 afford another of the common instances in insect increase and decrease. The influence of climate not only upon the insect itself but upon its natural enemies must be considered as the main factor which produces this result. The summer of 1889, it will be remembered, was marked by an extraordinary and almost continuous rainfall, while the precipitation in the summer of 1890, though great, was much less. Breeding, as this insect does in dung, it is plausible to suppose that its chances for successful transformation will be better in dung kept continually moist than in dung which dries at once. Should this supposition, which we are quite inclined to believe, be correct, the 1889 abundance and the 1890 scarcity are readily explained. The insect is so new as a stock plague, however, that the experience of future seasons must decide whether, as now seems likely, the species will be scarce in seasons of drought and numerous in summers when the precipitation is abundant.

The very commonest of the Dipterous insects which breed in cow dung through Virginia was found to be the common blue-bottle fly (*Lucilia cæsar*). In many fields Mr. Howard found that almost every dung dropped the previous day contained one or more clusters (a hundred or more eggs in a cluster) of the elongate white eggs shown at Plate VII, Fig. 2 *a*, *b*, *c*, *d*. They were almost invariably hidden from view and had evidently been laid after the dung had dried sufficiently to become a little hard on top. The eggs had then evidently been thrust into a crack and placed in little erect bunches beneath the surface. There is no danger that this insect will ever be mistaken for the horn fly in any of its stages except that of the young larva. The eggs are comparatively slender and much longer than those of the horn fly, and the full-grown larva and the puparium are twice as large as the corresponding stages in the latter insect. The young larva, however, may be distinguished by the lack of the ridged lamellar structure of the head, so noticeable in the corresponding stage of the horn fly. From abundant material brought in by Mr. Howard it was ascertained that an entire generation of the blue-bottle fly averages in midsummer from ten to fourteen days in duration. The numbers in which the adults issue from the dung are almost inconceivable—every morning for several days the breeding cage was apparently full of a swarming mass of flies.

SOME NEW ICERYAS.

[Plate I.]

No person living in the State of California will for an instant doubt the importance of carefully studying the habits and characters of any new species of the now well-known genus Icerya. Up to the present year but two species of this genus have been known. The one is the sugar-cane pest of Mauritius (the *Pou blanc* of the French planters), scientifically known as *Icerya seychellarum* Westwood, or *I. sacchari* Signoret, and the second is the now celebrated fluted scale of California (*Icerya purchasi*), to which we have devoted so much attention during the past four years and which has occupied many pages in annual reports prior to this one.

During the present year no less than four new species have been added to the two already known. One of these has been described by Mr. J. W. Douglas as *Crossotosoma ægyptiacum*, but upon careful study we have concluded that it should be more properly placed in the genus *Icerya*. It may be popularly called the Egyptian Icerya. The other three have been editorially described in INSECT LIFE under the names: *Icerya rosæ*, the rose Icerya; *Icerya montserratensis*, the Montserrat Icerya, and *Icerya palmeri*, Palmer's Icerya. The full technical descriptions of these new species will be found in INSECT LIFE Vol. III, No. 3, pages 94 to 105, and need not be repeated here.

The rose Icerya was sent to us last March by Passed Assistant Paymaster H. R. Smith, U. S. Navy, from Key West, Florida, on a limb of rosebush, with information that rosebushes on the Key were greatly troubled by the insect, which caused the stems to dry and the leaves to fall. It seems to infest other trees, including the sugar apple, lime, and lemon. We have shown the adult insect and its appearance upon rose on Plate I, Figs. 1, 2, and 3.

The Egyptian Icerya occurs in the gardens of Alexandria, Egypt, appearing first on the Banyan tree and spreading to many other plants. It has killed off many trees and has caused great alarm. A striking peculiarity of the species is the possession by the female of long waxy projections which shower down from the trees when a breeze is blowing.

The Montserrat Icerya occurs upon the Island of Montserrat, West Indies, and infests there a species of *Chrysophyllum*, known to the inhabitants of the island as Galba or Galaba tree. It is also stated to occur, though less abundantly, upon fig and citrus trees. This species resembles the Egyptian Icerya in the possession of the long waxy projections. (Plate I, Figs. 4 and 5.)

Palmer's Icerya occurs upon grape in the Province of Sonora, Mexico, where it was collected by Dr. Edward Palmer in 1887. The specimens received occurred upon the grape leaves along the main ribs and principally along the under sides in great numbers. Dr. Palmer found only one variety of grape infested, namely, the Muscat of Alexandria. (Plate I, Figs. 6 and 7.)

There is danger that this last species and the one occurring in Montserrat may some day make their appearance within our boundaries, and the fruit growers of Florida should take all possible pains to prevent such introduction. They would be justified in quarantining against plants from the West Indies until authoritatively

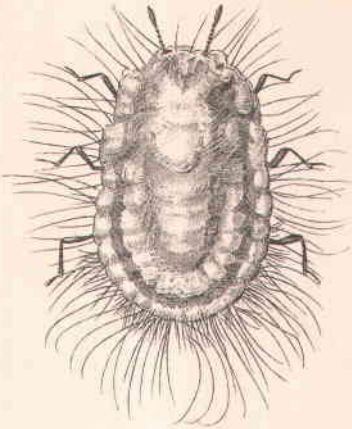


Fig. 1.

Fig. 2.

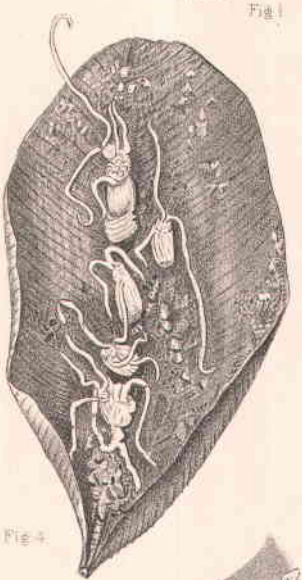


Fig. 4.

Fig. 5.

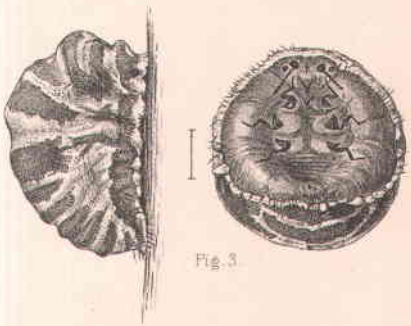


Fig. 3.

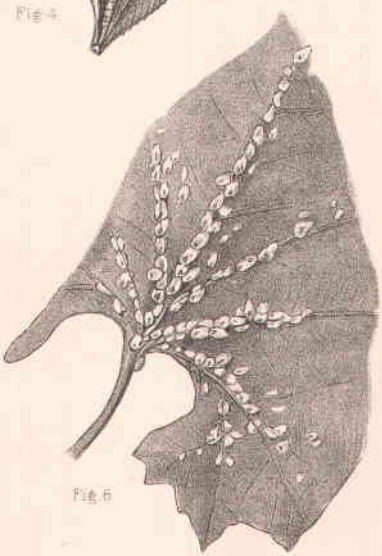


Fig. 6.

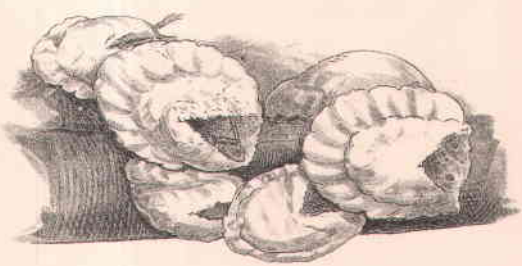


Fig. 7.

Geo. S. Harris & Sons Lith. Phila.

NEW SPECIES OF ICERYA

examined, as would also the people of Texas and California against plants from Mexico. We shall, as soon as the most favorable opportunity offers, endeavor to colonize the Vedalia on the infested plants of Key West.

EXPERIMENTS AGAINST THE BLACK SCALE.

(*Lecanium oleæ* Bernard.)

[Plate VII, Fig. 1.]

The so-called black scale (*Lecanium oleæ*) has for a number of years been a somewhat serious pest in certain of the California orange and lemon groves. Originally a foe to the olive, it has spread to various other trees and is found commonly on the oleander, peach, and apricot, as well as upon citrus trees. It secretes a large amount of honey dew, and is hence followed by a greater abundance of the smut fungus (*Fumago salicina*) than are any of the other commoner scales. It is an extremely prolific species, although probably having but one annual generation, and would doubtless become a scourge were it not for the fact that it is extensively parasitized by *Dilophogaster californica*, a Chalcid fly which breeds rapidly and is at times very abundant. In 1880 Professor Comstock found that at least 75 per cent of the black scales upon more than one tree in the vicinity of Los Angeles had been destroyed by this parasite, while in 1889 Mr. Coquillett reported an almost equal destruction of the scales from the same cause. A curious fact is that while the Black Scale is directly or indirectly of European origin, the parasite evidently belongs to the Australian fauna, nothing like it being known to occur in Europe.

Californians as yet have done little in overcoming this specific scale, their attention having been so largely occupied with the more important fluted scale (*Icerya purchasi*) and red scale (*Aonidia aurantii*). With the disappearance of the former, however, through the work of the Cardinal Vedalia, and the recent success and great reduction in the cost of the gas treatment of the black scale, the San José scale (*Aspidiotus perniciosus*), the flat or soft scale (*Lecanium hesperidum*), and others of less prominence will doubtless receive more attention.

Mr. Ellwood Cooper, of Santa Barbara, has probably paid more attention to the matter of remedies for the black scale than any other California horticulturist, and after somewhat extensive experiments with the caustic washes and whale oil soap and other substances such as hot tobacco water, has finally fallen back upon the substance which we should have first recommended, viz, kerosene emulsion, which he applies hot and makes in the following manner:

Five gallons best kerosene oil, 150° test; 1½ pounds good common soap or one bar and a half of soap usually sold as pound packages; 2½ gallons of water. This makes the emulsion. When using dilute 6½ to 7 gallons of water for each gallon of oil and to this mixture add 2½ pounds of good home-made soap dissolved in boiling water. All this mixing is done with hot water. We usually have the solution up to 140° in the tank from which we spray.*

Our attention was called to the desirability of further experiments last September by Prof. W. A. Henry, director of the Wis-

*Biennial report of the State Board of Horticulture, 1885–'86, Sacramento, 1887, p. 378.

consin Agricultural Experiment Station, and at his suggestion we sent Mr. Coquillett to Chula Vista, California, for the purpose of making a trial of a modification of the Nixon pump, invented by Mr. E. S. Goff, of the Wisconsin Station, whereby kerosene is drawn from one vessel, water from another, and the two mingled in the chamber of the pump and thrown from the nozzle, in Professor Henry's words "as a very fine emulsion." The object of the modification was to do away with the trouble and expense of keeping the kerosene properly suspended in the water. We were glad to have an opportunity to test the modification, although realizing that a mixture made in this way would not be an emulsion proper. We therefore instructed Mr. Coquillett to conduct certain experiments on the black scale at Chula Vista with this machine and to check them by a series of tests with a carefully prepared emulsion.

The results can be best presented in Mr. Coquillett's own words, as follows:

The inclosed figure illustrates the pump in question, and I have added in pencil a sketch of the attachment to this pump as first used by Professor Goff, of the Wisconsin Experiment Station. In spraying kerosene upon the tree the water or soapsuds is drawn up by the larger hose and the kerosene by the small tube attachment, the two being drawn up by the same operation of the pump, mingled together and sprayed upon the trees. There is a stopcock in the upper part of the tube attachment by means of which the quantity of kerosene drawn up by the pump may be regulated.

I tested this pump by using soapsuds and kerosene according to your formula, one-half pound of hard soap dissolved in hot water, then diluted to make 28 gallons, to be used with 2 gallons of kerosene. After adjusting the pump so that it would draw up 2 gallons through the tube attachment at the same time that it would draw up 28 gallons through the large hose, I sprayed several trees with the above mixture and also sprayed some of it into a bottle in order to ascertain how long it would take for the kerosene to separate; it produced a whitish emulsion similar in appearance although a shade lighter in color than that made in the ordinary way. The oil remained in suspension for three or four hours. On the morning of the third day nearly all of the oil had separated out, forming a layer of pure oil over the surface of the soapsuds. I also made an emulsion of the above ingredients in the ordinary way, dissolving the soap in 1 gallon of water by boiling, and while hot added the kerosene and pumped this back into the same vessel again through the spraying nozzle, continuing this for about five minutes; this formed a thick, creamy substance which diluted perfectly with water, and I added water to it until the whole measured 30 gallons.

Some of this I sprayed into a bottle as I had done with the previous emulsion, and on the morning of the third day only one third of the oil had separated out. It thus appears that when the kerosene and soapsuds are drawn up separately by means of the tube attachment, the emulsion formed is only one third as stable as that made in the ordinary way. Whether or not this will make any difference with the effect of the kerosene on the trees and insects sprayed with it can not be determined at the present time, as it will require several weeks for the kerosene to exercise its full effects upon the trees and insects. I also used pure water in place of the soapsuds, but after remaining quiet in the bottle that I sprayed some of it into, all of the kerosene separated out at the end of about three minutes. I have sprayed several trees with each of the three emulsions mentioned above, and will note the comparative effects of each and report to you later on.—[September 24, 1890.

I have just returned from Chula Vista, where I went to ascertain how my experiments with Professor Henry's pump turned out. At my previous visit, September 20, I applied the kerosene according to Hubbard's formula (kerosene, 6¾ gallons; hard soap, 1¾ pounds, and water enough to make 100 gallons), both by making an emulsion of it and also by emulsifying it at the time of spraying it upon the trees with Professor Henry's pump, but I was unable to see any difference in the effects. In neither instance were the trees injured, nor were the *Lecanium oleæ* and *hesperidum* exterminated. The trees operated upon were less than 5 feet tall and were lemons and olives. I sprayed one of the olive trees with the above emulsion, emulsified in the usual manner, with a solution of arsenic and bicarbonate of soda added, 1 pound of each to 864 gallons of the emulsion, but this did not prove fatal to the *Lecanium oleæ* sprayed with it. I also used the emulsion about one third stronger

than above indicated (kerosene, 10 gallons; soap, 1⅛ pounds; water enough to make 100 gallons), and sprayed it upon one olive and three lemon trees with Professor Henry's pump; the lemon trees were not injured but several leaves at the tips of some of the branches on the olive trees were killed; but the *Lecanium oleæ* and *hesperidum* were not all of them destroyed by the wash. At the above proportions, each gallon of this emulsion would cost about 2½ cents.

These experiments lead me to believe that the effect of the emulsion is essentially the same whether it is first emulsified in the ordinary way or by the use of the pump sent by Professor Henry. At the time of making the above tests I also tried the resin wash according to the formula given in my last year's report to you (resin, 18 pounds; caustic soda, 5 pounds; fish oil, 2½ pints, and water enough to make 100 gallons); this I sprayed on an olive tree and two orange trees; neither of the trees were injured by the wash; on the olive I found only one living *Lecanium oleæ*, but on the orange trees neither myself nor Mr. Adams, Professor Henry's foreman, were able to find a living *Lecanium hesperidum*. This wash costs less than 1 cent per gallon.—[October 28, 1890.

THE GREEN-STRIPED MAPLE WORM.

(*Anisota rubicunda* Fabr.)

Order LEPIDOPTERA; Family DFYOCAMPIDÆ.

[Plate V, fig. 3; Plate VI.]

Our attention is drawn from time to time to the ravages of the larvæ of *Anisota rubicunda* on soft maple trees, particularly in the central Western States. These depredations are the more noticeable and serious on account of the importance of the swamp or soft maple in all forest and ornamental plantings in the West, where it is one of the favorite trees on account of its rapid growth and the minimum of care and attention needed in its propagation. The sole drawback is the liability of its being defoliated once or twice yearly by the larva under consideration, and this has led, in frequent instances, to the replacing of these trees by other and perhaps less desirable varieties. This course is entirely unnecessary, as the maple can be easily protected by the application at suitable times of either of the common arsenical poisons, Paris green or London purple.

A very characteristic onslaught of the green-striped maple-worm has been experienced the past summer at Lincoln, Nebraska, and seems to have been left to run its course unchecked. We give, as of interest in this connection, a view of the main building of the State University with a row of large maple trees in front defoliated by this insect. This illustration is reproduced from a photograph obtained in July last for us by Mr. Lawrence Bruner, and indicates at once the thoroughness with which maples are sometimes stripped by these larvæ and the neglect by the proper authorities in this instance of all measures against them. We have seen similar complete defoliation in years gone by on the grounds of the State Agricultural College at Manhattan, Kansas, and on those of the State University at Lawrence. The frequent recurrence of this insect will warrant the reproduction, in the main from our Fifth Report on the Insects of Missouri, of a brief account of its range, life history, and the preventive and remedial measures to be employed against it.

RANGE AND LIFE-HISTORY.

While especially abundant in the West, this insect has a wide

range, extending through the Eastern States and Ontario. It has been observed as far east as Brunswick, Maine, by Dr. Packard, and in the District of Columbia it not infrequently occurs in great numbers and attacks both the swamp and silver maples. In the West it is reported more frequently from Illinois, Missouri, Iowa, Nebraska, and Kansas, in most of which States the soft maple is indigenous, a fact which accounts for the excessive multiplication of the insect there as compared with the more eastern sections of the country.

It feeds on other maples and presumably on all species of the genus Acer, and when forced to from necessity will feed on oak, though normally never found on that genus of trees, and probably incapable of full development thereon.

The eggs are deposited by the parent moth in batches of thirty and upward on the under side of leaves. The number matured by a single moth is large, in one instance 145 eggs were laid by a moth in captivity and in another 102 eggs were laid. The insect died in the latter instance before oviposition was completed, as examination revealed many more eggs still in her abdomen. The egg is about 0.05 of an inch long, suboval, slightly flattened, pale greenish, becoming yellowish and showing the black head of the inclosed larva just before hatching, and is hatched in eight or nine days after being deposited. The larvæ undergo four molts and reach full growth in about a month, when they enter the ground and transform to pupæ.

The worms (Fig. 3 *a*) are longitudinally striped with pale and dark green lines, and are chiefly distinguished by two anterior projecting black horns on the top of the second segment, and by having segments 10 and 11 a little dilated and rose-colored at the sides.

The pupa (Fig. 3 *b*) is of a deep brown or black color, very much roughened and armed with curved horns and points about the anterior extremity and also on the last joint, which terminates in a long bifurcate projection. The pupæ of the first brood give forth the perfect insect in fourteen to sixteen days, those of the second brood usually wintering over in the ground. In the West there are usually but two broods in the year, but experiments here in the District indicate that three broods are occasionally produced.

The pupa, before giving out the imago, works its way to the surface by the aid of its spines, allowing the ready escape of the moth. The moth is of a pale yellowish color shaded with pink, as in the figure (*c*) which represents the female. The male has a smaller abdomen and broad bipectinate antennæ. Different specimens vary greatly—the yellow predominating in Western and the rose-color in Eastern specimens, while others again, especially from the West, are nearly or quite white in color—this form having been unnecessarily described as a new species by Mr. A. R. Grote.

PARASITES.

We mentioned in the Missouri report cited a number of insect parasites, and we believe the list has not been added to by subsequent writers. These are: *Tachina anonyma* Riley, *Belvosia bifasciata* Fabr., *Limneria fugitiva* Say. We have in our notes, however, the record of the breeding of an egg parasite, probably either a *Telenomus* or a *Trichogramma*, by Mr. William Saunders. These parasitic insects very effectually aid in the control of the worm, which in fact seldom occurs two years in succession in injurious numbers.

MEANS AGAINST.

Spraying with Paris green or London purple in the proportion of 1 pound to 125 to 150 gallons of water as soon as the young larvæ are noticed, or a week or ten days after the moths appear in the spring, is at once the simplest and most effective remedy. Apparatus suitable for this work has been repeatedly described and illustrated in various publications of the Division, and now that the benefits of spraying against nearly all insects have been so conclusively and repeatedly shown, such apparatus should certainly be in the possession of every progressive farmer or orchardist, and also of every municipality. The initial cost would be more than saved the first season. For spraying large trees an ordinary direct discharge nozzle will answer very well, or, better still, the Nixon nozzle, made by A. H. Nixon & Co., Dayton, Ohio, from whom also a complete spraying outfit may be obtained if desired. If the larvæ have been allowed to reach full growth so that spraying will be of no use, great numbers of them can be entrapped and easily destroyed, as stated in the report cited, by digging a trench either around the individual trees or around the groves or belt. The trench should be at least a foot deep, with the outer wall sloping under. The larvæ usually wander from the trees before entering the ground, and will collect in numbers in the trench or bury themselves in the bottom, and may then be easily killed.

Their numbers may be reduced also by keeping a sharp lookout for the moths and eggs during the latter part of May, when both may be destroyed in large quantities.

A NEW PEACH PEST.

(*Ceratitis capitata* Wied.)

Order DIPTERA; Family TRYPETIDÆ.

[Plate III, Figs. 1 and 2.]

A dangerous enemy to the peach crop exists in Bermuda, as we have ascertained during the past season, and the frequent importation of fruit from that island to this country renders possible the introduction at any moment of this injurious insect into our territory. We have, therefore, taken some little pains to ascertain all that is known about it. Our material has been furnished us by Mr. Claude W. McCallan, of St. George's, Bermuda, and a preliminary article upon the species was published by us in INSECT LIFE, Vol. III, No. 1, August, 1890. The insect is a two-winged fly of the family *Trypetidæ*, and is allied to the apple maggot (*Trypeta pomonella*) of this country.

Infested peaches were received from Mr. McCallan in April, and early in May the adult flies were reared and proved to be the *Ceratitis capitata*, long since known as a pest to the orange crop in various parts of the world, but not yet found within the limits of the United States. The regions most affected are the East Indies and the Azores Islands, where the insects abound upon citrus fruits. The same or a closely allied species is found upon the Island of Malta, and is at present being investigated by a committee charged by the governor of that English possession with the preparation of a report. In Spain, Algeria, and Sicily a species known as *C. his-*

panica, but which may possibly be the same insect which we have under consideration, has been found and has been studied recently by Dr. O. Penzig in Sicily. The female penetrates the skin of the half-grown orange and lays her eggs at the depth of from 1 to 3 millimeters and in a few days the larvæ hatch and burrow through the skin and into the pulp of the fruit, rendering injured fruit partly recognizable by a brown or olive spot, which soon extends to from 3 to 5 centimeters in diameter. The original puncture is always noticeable and the larva returns to it frequently for air, placing its anal spiracles against the opening. The orange soon falls to the ground and in the space of fifteen days, more or less, the larva issues either through the original opening, or through another one made for the purpose, and enters the ground, where it transforms to pupa, remaining in this condition only a few days. There are presumably a number of annual generations. The orange is preferred to lemons and other cultivated citrus fruits, which are, however, attacked, as also peaches, figs, and azaroles. Curiously enough in Liguria Dr. Penzig found it damaging peaches, but he was not able to verify its presence in oranges or lemons. The remedy proposed was to collect and destroy the infested fruit or to submerge it for a short space of time in water. As a means of destroying infested fruit he proposes to place it in a ditch, cover with a layer of caustic lime, and thus convert the whole mass into a valuable fertilizer.

In Bermuda the species which we are considering seems to have the same peculiarity as that observed by Dr. Penzig in Liguria, in that it has forsaken citrus fruit for peaches and probably for Surinam cherries, mangoes and probably also for the Loquat or Malta plums. It has been known to infest the peach for twenty-five years but has not actually been reared so far as we can find from any other fruit. At our request Mr. McCallan searched for the flies upon the citrus trees and found a few specimens lodging upon some lime trees and fruit. No damage to this fruit, however, seems to be known in that locality. Oranges and lemons are very little grown owing to diseases of every kind and in particular (judging from Mr. McCallan's description) the foot rot (*mal de goma*) and rust. It is not unlikely that this partial abandonment of citrus culture and the destruction of the trees from disease was the cause of the transfer of the attention of the Ceratitis to peach. Just at this time of writing, however, we have received a letter from Mr. McCallan who states that he has been informed by a Mr. Swainson, a reliable man and a great observer of nature, that he had in his yard some bitter Seville oranges, from which marmalade is made, so badly attacked by this fly year after year that he cut the trees down. Other persons living in the vicinity where this sour orange is to be found wild and who market the fruit at Christmas time for the purpose of making marmalade told Mr. McCallan that they had never seen any of the oranges injured in the slightest degree by the maggots which are to be found infesting the peach.

Owing to damage done to the peach crop many persons have cut down their trees and peaches are now comparatively scarce, although formerly they were most abundant and could almost be said to grow wild. This tree blossoms in January and when the fruit is one third grown it is punctured by the fly. It continues to grow but instead of ripening suddenly becomes quite soft and decayed and drops from the tree to the ground full of maggots and perfectly useless. The insect is shown upon Plate II in all of its stages. The larva leaves

the fruit and to transform enters the ground from one fourth to 2 inches below the surface. The development is very rapid and there must be from six to eight generations in the course of a year provided food is at hand, and when peaches are not obtainable the other fruits just mentioned will without doubt be attacked. The Surinam cherries and mangoes ripen during the summer months while the Malta plums blossom in October and ripen about the following March. These fruits, therefore, with the Peach, will suffice to carry the insect through an entire season.

Owing to the fact that the female deposits her eggs under the skin of the fruit, the application of arsenical poison will be of no avail, but the collection and destruction of the fruit through any one of the ways proposed by Dr. Penzig will prove an adequate preventive provided it is done in concert over a given neighborhood and thoroughly done. It will not suffice to simply collect and destroy fallen peaches, as from Mr. McCallan's information the Malta plums are in fruit at the same time. The latter, therefore, should be also watched and all fallen fruit gathered and destroyed. There may be other fruit infested by the same insect which will also have to be watched and in localities where the Surinam orange grows it will also be fruiting at the same time and examination should be made for the purpose of ascertaining whether this fruit is also infested.

Mr. McCallan is of the opinion that the insect was originally introduced into Bermuda during the American civil war in cargoes of fruit brought from the Mediterranean region. These cargoes were intended for the American market but from stress of weather and other causes the vessels had to put in at Bermuda for repairs, etc., and the insects finding a congenial habitat, flew out and began to reproduce.

Judging from what has been written about this species it is a tropical insect and there is consequently little danger that it will thrive in the Northern States, but peaches are grown extensively in Georgia and many fruits which are liable to be attacked are cultivated in Florida. Although peaches are not now received in bulk from Bermuda, the accidental importation of the pest is always possible. Once imported into Florida its extermination would be almost impossible. We send out this note of warning for the benefit of those interested.

THE ROSE CHAFER.

(*Macrodactylus subspinosus* Fabr.)

Order COLEOPTERA; Family SCARABÆIDÆ.

[Plate V; Figs. 1 and 2.]

Inasmuch as we have not hitherto treated of this notorious insect in any of the annual reports of this Department we have thought best to introduce here a condensation of an article which we published in the April number of INSECT LIFE (Vol. II, No. 10), and which gives a fair summary of the life history of the species with an account of the remedies. Some account of this insect is particularly timely in the present report for the reason that the season of 1890 since the publication of the original article) has been marked by an extraordinary abundance of this insect in certain sections. Some

points brought out in our own correspondence during the summer and by the work of other entomologists, particularly Professor Smith, of the New Jersey Experiment Station, will also be referred to.

NATURAL HISTORY.

According to Harris the female beetle lays her eggs to the number of about thirty, about the middle of July, at a depth of from 1 to 2 inches beneath the surface of the ground. He does not state the favorite place for oviposition, but in our experience the larvæ are especially abundant in low, open meadow land or in cultivated fields, particularly where the soil is light and sandy. Harris states that the eggs hatch in about twenty days, and, while the period will vary with the temperature, the larva is found fully grown during the autumn months. With the approach of cold weather it works deeper into the ground, but in the spring will frequently be found near the surface or under stones and other similar objects, where it forms a sort of cell in which to pupate. In confinement the pupa state has lasted from two to four weeks. The perfect beetle issues in the New England States about the second week of June, while in the latitude of Washington it is seen about two weeks earlier. It appears suddenly in great numbers, in conformity with the habits of other Lamellicorn beetles, *e. g.*, our common May beetles (genus *Lachnosterna*). It remains active a little over a month and then soon disappears. The species produces, therefore, but one annual generation, the time of the appearing of the beetle in greatest abundance being coincident with the flowering of the grapevine.

FOOD PLANTS AND RAVAGES.

The food of the larva consists of the roots of grasses and probably also of other low plants. Whether it also feeds on the rootlets of trees and shrubs has not been definitely ascertained, although the larvæ have been found quite numerously around the bases of oak trees, near Washington, both by Mr. Koebele and Mr. Schwarz. We found them quite numerous in the sandy lowlands of the Merrimac Valley, New Hampshire, on cultivated ground, where they must have fed on the roots of various weeds or on those of meadow grass and cultivated rye and maize. It is probable, however, that they occur yet more numerously in unplowed pasture and meadow land than in cultivated fields. We have also recorded the fact that they exceptionally feed upon the egg-pods of the lesser migratory locust or grasshopper (*Caloptenus atlanis*). The beetle has a partiality for flowers, but also feeds upon leaves of various trees and bushes and attacks certain fruits. It has a predilection for the flowers of roses, wild as well as cultivated,* and, in the experience of many observers, prefers white roses to red ones. Harris states that the beetle was first noticed on the rose (hence its popular name), and that it afterward acquired the habit of feeding on grapevines and fruit trees. Another favorite food is the blossom of the grapevine, with a decided preference for that of the Clinton. Flowers of raspberries and blackberries do not escape its ravages. Mr. E. H. Miller states, in the American Agriculturist (see Amer. Nat., v. 17, 1883, p. 1291), that the flowers of *Deutzia scabra* are even preferred by the beetle to those of the grapevine. The blossoms of the various

* The Cinnamon Rose (*Rosa cinnamonica*) is said to enjoy immunity.

species of *Spiræa* are often crowded with the beetles, and the same may be said of the blossoms of the sumach, the common ox-eye daisy, *Magnolia glauca*, mock orange, and some other plants. This list could be greatly extended, but we close it with the statement that the beetles also devour the blossoms of *Pyrethrum cinerariæfolium*.

The foliage of most, if not all, of our cultivated fruit trees, and especially apple, pear, peach, cherry, and plum, at times suffers greatly, the two last-named trees being apparently more attractive than the others. The foliage of cultivated grapevines is almost as eagerly devoured as the blossoms, and the leaves of oak, alder, and other forest trees also serve as food. Of low-growing plants the beetles cut the leaves of strawberries, rhubarb, and of nearly all garden vegetables, as also of sweet potato, corn, wheat, grass, and many wild plants.

Not satisfied with this amount of damage, the beetles attack the fruit of peaches, cherries, apples, and grapes when just forming.

The statement that the beetle is poisonous has no foundation in fact.

REMEDIES.

It has been assumed by most writers that we can not successfully attack the rose chafer in any of its earlier stages. To search for the eggs in the ground would be impracticable. It does not, however, follow because of the poor success that has generally resulted from attempts to destroy similar larvæ that they can not be successfully destroyed. In the case of the common European cockchafer (larva of *Melolontha vulgaris* and *hippocastani*) and of our own white grub (*Lachnosterna fusca*) the methods adopted have consisted of plowing and hand-picking. The experiments made, however, on a similar larva with the kerosene-soap emulsion, as narrated in INSECT LIFE (Vol. I, p. 48), clearly show that we have in this insecticide a means of successfully destroying the bulk of the larvæ of the rose bug wherever they are known to be sufficiently abundant to justify such treatment. A thorough investigation should be made in the direction of ascertaining the preferred breeding grounds of the species, and it were rash to say here that we have no effectual mode of preventing the insect, notwithstanding the disfavor in which this mode of warfare has been held in the past.

It is evident, however, that for the present we should concentrate our efforts on the destruction of the beetles especially when they first issue from the ground and congregate in the garden on our roses, grapevines, and fruit trees. A brief statement of the various methods that may be employed for this purpose may prove advantageous. Hand-picking and killing the beetles either by crushing them or throwing them into hot water, or water having a scum of kerosene upon it, has proved useful and satisfactory in a limited way, as also the shaking and knocking down of the beetles into pans or upon sheets saturated or smeared with coal oil.

These measures are best carried out and most satisfactorily in the early morning hours and toward evening, as the beetles are then more sluggish and not so quick to take wing as they are during the heat of the day. White roses, Spiræas, or Deutzias, planted on a place, will attract great numbers of the beetles, and thus not only facilitate the destruction of these last, but act as a kind of protection to other plants.

As to other topical applications intended to destroy the beetles, whether directly or by poison taken with the food, the experience with the arsenites is that they are of little avail, and the experience with other materials, like hellebore and pyrethrum, has been so conflicting that we can not consider either of them reliable or satisfactory. Pyrethrum would seem to have given on the whole the most satisfactory results.

The trouble with all these remedies is that the beetles during their brief season continue to issue from the ground and to congregate upon their preferred plants in such numbers, under favorable circumstances, that however fatal an application may be it has to be continued, and the most persistent may justly become discouraged in a fight with these beetles when they are abnormally abundant and swarm to the extent we have known them.

With this insect as with many others success will only follow diligence in the combined application of the insecticides that have been found effective, and the persistent shaking on to sheets or stretchers saturated with coal oil. A few choice plants may be protected by covering with netting. Another protective measure is to dust the plants with air-slacked lime or gypsum, or to spray with lime water, from one half to one peck of lime to a barrel of water.

ADDED EXPERIENCE DURING THE SUMMER OF 1890.

Since the publication of the article in INSECT LIFE we have had some interesting correspondence on the subject of the Rose Chafer.

Mr. J. S. Strayer, of Port Republic, Virginia, wrote, under date of July 2, emphasizing the fact that the insect breeds in sandy land and that it has never been known to attack vegetation upon clay lands. This statement is exaggerated, as the beetle is a strong flyer and when sufficient food is not found in its breeding places it will fly to the nearest point where food is abundant and will attack it whether upon clay or sandy land. An interesting point which shows the certainty with which the breeding in sandy soil is known, is brought out by Mr. Strayer in a statement to the effect that it has even been recommended by gentlemen in his neighborhood to place clay around the roots of grapevines as protection. This recommendation is of little or no value under the circumstances.

Mr. John K. Hoyt, of Luther, North Carolina, wrote us July 21 that jarring the vines and catching and destroying the beetles made no perceptible diminution in their numbers. He thought his entire grape crop was doomed, but after spraying a row of one hundred vines with London purple, at the rate of 1 pound of the poison to 150 gallons of water, the beetles entirely deserted them within two days. The spraying was done on May 29, so that the disappearance was entirely produced by the remedy.

June 19 we received a letter from Mr. E. H. Wynkoop, of Catskill, New York, reporting upon some experiments with pyrethrum (4 ounces to 5 gallons of water) and with hellebore without effect. Shaking upon a stretcher saturated with crude petroleum he found quite effective. A neighbor told him that he had driven the beetles from his vineyard by burning pieces of old rubber between the rows.

Mr. S. Justus, of Mentor, Ohio, wrote, June 22, and again November 27, concerning his use of a mixture of unslacked lime and carbolic acid in water in the proportion of 1 bushel of unslacked lime to 1 quart of acid and 50 gallons of water. He applied the dose

freely and his vines looked white when he finished. He sprayed at the rate of 5 acres per day and lost no grapes afterwards. The mixture had no injurious effect on the vines and the experiment was satisfactory for the reason that a large untreated check patch was left, on which the crop was entirely destroyed.

In none of the localities mentioned, however, was the rose chafer as abundant as it seems to have been in parts of New Jersey and Delaware. The numbers in which they occurred in the two latter States, as described by Professor Smith, Mr. Beckwith, and others, would seem almost incredible to one who has not seen one of the great incursions of this species. The result was that neither of the gentlemen mentioned were able to find any remedy which would effectually protect vegetation. Myriads of beetles were destroyed but their places were filled by others, and by sheer force of numbers the effect of all remedial work was vitiated. Professor Smith found that there was scarcely a plant which they did not eat, although flowers and some fruits are always preferred. He experimented with pyrethrum, tobacco, London purple, powdered naphthaline, pure and mixed with carbonate of lime, hellebore, foxglove infusion, digitaline, quassia and copper compounds, iron solution, kerosene emulsion, corrosive sublimate, sludge-oil soap, and a mechanical apparatus consisting of an umbrella with a sack attached. In his opinion the only way to save the crops is to plant spiræa, roses, or blackberries between some rows of the vineyard. These plants are preferred by the Chafers, and by persistent collecting they can be kept from the grapes.

The experience of the past season was discussed at the meeting of the Association of Economic Entomologists at Champaign, Illinois, early in November, and the report of this meeting will be found in INSECT LIFE, Vol. III, No. 5. An article by Professor Smith, reprinted from Garden and Forest, will be found in INSECT LIFE, Vol. III, No. 3.

THE WORK OF FIELD AGENTS.

A BRIEF STATEMENT OF THE WORK OF THE FIELD AGENTS OF THE DIVISION.

Mr. D. W. Coquillett, the agent stationed at Los Angeles, California, has devoted most of his time during the past year to the further improvement of the apparatus and methods used in fumigating orange trees as a remedy for the red scale (*Aonidia aurantii* Maskell). This process, which is the outgrowth of the experiments which we began at Los Angeles in 1887, and which was described in full in our annual report for that year, was, by the work of the season of 1889, much simplified and the cost of its use was reduced about one third. The expensive machinery figured upon Plates IV, V, and VI of the 1887 report has been greatly simplified, with a corresponding reduction in cost. During the present season still simpler apparatus has been devised and the arrangements have been so perfected that it is now possible for the planter to fumigate his orchard at the rate of thirty to forty trees a night. Most large orchardists, however, use as many as six tents at once, and in one case four men, using six tents, fumigated two hundred and forty trees in one night. During the past season over twenty thousand trees have been fumigated in Orange County alone, and the red scale is being rapidly

reduced in numbers. Mr. Coquillett is convinced that better results are obtained than by the use of any kind of spray, and many instances have occurred where upon large trees treated with the gas he was unable to find a single living red scale, a result which it would be hardly possible to obtain by spraying. An interesting point which has been brought out is that the trees are less liable to injury when fumigated at night than they are when operated upon in the daytime, while the gas is just as fatal to the insects at night. This is accounted for by the fact that in the daytime the light decomposes the gas into other gases, which, while being more hurtful to the trees, are not so fatal to the insects. Moreover the trees are more or less in a state of rest at night. Mr. Coquillett reports in full upon apparatus, methods, and preparations.

During the winter he carried on a series of experiments with washes against another very injurious scale insect, viz, the San José or pernicious scale (*Aspidiotus perniciosus* Comstock), using several substances heretofore not experimented with upon scale-insects, such as salt and water, salt and slacked lime, sulphur, corrosive sublimate, glue and aloes. The high price of the latter would debar its general use, but the results were exceptionally good. Of the substances experimented with the resin wash first introduced in Mr. Koebele's experiments for the Division was found to be one of the most efficacious as well as the cheapest.

Mr. Lawrence Bruner, the agent of the Division stationed at Lincoln, Nebraska, has investigated an outbreak of a local grasshopper—*Camnula pellucida*—which has for the past two or three years been appearing in numbers in parts of Idaho and Utah, but the greater part of his work has been connected with the collection and study of the insects injurious to the sugar beet, as the State of Nebraska has recently taken up the cultivation of this crop to a considerable extent. Mr. Bruner has found that no less than sixty-four different insects prey upon this crop at the present time, and the major part of his report is taken up with the enumeration of these species and comments upon them. The beet crop is an easy one to which to apply remedies, for, like the potato, the tops are valueless after a certain stage of growth and solutions so strong as to seriously injure them do not affect the root. Therefore, by a thorough use of arsenical solutions and strong kerosene emulsion the crop can be kept free from insects.

The report of our Indiana agent, Mr. F. M. Webster, on insects affecting cereal grains, relates largely to experiments and observations extending over a period of more than six years, to determine the number and development of broods of the Hessian fly. His observations and experiments have been made chiefly in the State of Indiana. He has found that the double-brooded habit of this insect, long ago pointed out by Dr. Fitch, holds true for ordinary seasons throughout Indiana. The fall brood in the southern portion of the State he finds to appear some weeks later than in the north and between the spring and fall broods retarded individuals of the one and accelerated individuals of the other brood appear, rendering the strict limitation of the other broods in some cases difficult, or giving the appearance of an intermediate third brood. The additional third brood, if it ever occurs, is certainly abnormal and unimportant, as shown by experiments carried out in the field and not subject to the vitiating influences of the breeding cage.

The usual time of appearance of the fall brood in southern Indiana

is from the last of September to the first of October, so that to escape the attacks of the fly wheat in this region should be sown soon after the first of October.

In the northern half of Indiana the flies appear from two to three weeks earlier, and experience has practically indicated that in this part of the State wheat sown between the 15th and 25th of September is the most likely to escape the attacks of the Hessian fly.

The later appearance southward of the fall brood has been noted by all observers. Mr. Webster's experiments give more accurate information as to dates of appearance of the flies and, therefore, of the best time for seeding in the region under study and will be of great practical value to the Indiana farmer. His conclusions will also apply to a large part of our wheat belt.

The report on this insect also includes some interesting observations on the effect of the larva on the plants, particularly in the matter of color, of the effect of the weather on the development of the fall brood, and concludes with a review of the preventive and remedial measures.

The report further contains a brief account of the European grain Toxoptera (*T. graminum*), which during the last few years has been very abundant in certain sections in the West and Southwest, and which we instructed Mr. Webster early in the year to carefully investigate. Our knowledge of this recently imported grain pest is still far from complete, although the season's observations have added considerably thereto.

A short report on the grain aphis (*Siphonophora avenæ*), supplementary to our article in the Annual Report of the Secretary of Agriculture for last year, is given, and also brief accounts of the apple plant-louse (*Aphis mali*) on small grains, a new species of *Diplosis* and the twelve-spotted *Diabrotica*, of which latter unmistakable larvæ were found eating into the stems of young wheat.

The principal work reported upon by Mr. Albert Koebele, the agent at Alameda, California, is a series of experiments which he has carried on chiefly during the month of September in the Sonoma Valley to ascertain the effect upon the grape Phylloxera of certain of the resin washes which proved so valuable when used against the fluted scale. The results have been quite as good as we anticipated and the experiments have shown that in the use of these washes we have a most valuable addition to the remedies for this great pest.

The formula which gave most satisfaction is as follows:

Caustic soda (77 per cent)	pounds..	5
Resin	do ..	40
Water to make 50 gallons.		

The soda should be dissolved over a fire in 4 gallons of water, then the resin should be added and dissolved. After this the required water can be added slowly while boiling to make the 50 gallons of the compound. To this water may be added at the rate of 9 gallons for 1, making 500 gallons of the dilute compound, sufficient for one hundred large vines, at a cost of only 84 cents, or less than a cent a vine.

In addition to this work Mr. Koebele has studied the tent caterpillars of the genus *Clisiocampa* of the Pacific coast and has done some extensive collecting and breeding of fruit tree and garden pests in that section of the country. He has also done some excellent work in the study of parasites of the codling moth and of other injurious insects.

Miss Mary E. Murtfeldt divides her report into three sections: (1) general observations, (2) a few more injurious Microlepidoptera on apple, and (3) experiments with insecticides. Under the first head she gives a general account of the injurious insects of the season in Missouri, calling attention to the comparative immunity from the chinch bug, the canker worm, and cut-worms. The stalk borer (*Gortyna nitela*) and the corn ear-worm (*Heliothis armigera*) were particularly abundant, while the slug caterpillars or stinging caterpillars (family *Cochliopodidæ*) were noticed in unusual numbers. All through Missouri and adjoining States there was a notable outbreak of the walnut, hickory, and oak caterpillars (*Datana ministra* and *D. angusii*). One of the most interesting observations made by this agent was to the effect that the fall web-worm (*Hyphantria cunea*) was extensively preyed upon in Missouri this summer by the larvæ of a Carabid beetle, *Plochionus timidus*.

In the second section of her report she considers four new apple enemies: *Penthina chionosema*, *Proteopteryx spoliana*, *Steganoptycha* sp., and *Gelechia intermediella*. Under the head of experiments with insecticides are given accounts of experiments with X. O. dust, buhach, arsenites of ammonia, and petroleum sludge. It was found that dry X. O. dust blown from a bellows during the middle of the day is a thoroughly satisfactory remedy for plant-lice of all kinds. The arsenites of ammonia when used according to the manufacturer's directions, one tablespoonful to a gallon of water, proved to be an efficient insecticide, but badly scorched the leaves of peach and cherry, and damaged slightly the foliage of plum, apple, rose, and squash. The petroleum sludge arrived too late for satisfactory trial, but Miss Murtfeldt thinks that its intolerable and persistent odor is a serious obstacle to its general use, especially in small gardens.

The Iowa agent, Professor Osborn, has continued his work on the parasites of domestic animals and has submitted for publication in bulletin form that portion which relates to the Mallophaga. He has continued his observations on insects injurious to pasturage, a subject which received treatment in his report for 1889 (published in Bulletin No. 22 of the Division), and reports upon additional species of importance in this direction. He has also reported upon the insects of the season in Iowa, mentioning among others two pests new to the State, viz: Abbott's white pine worm (*Lophyrus abbottii*) and the potato stalk-borer (*Trichobaris trinotatus*). Some remedial experiments were also reported. He has found that in Iowa the arsenites of ammonia in the customary dilution do not injure the foliage of squash, cucumber, potato, plum, cherry, box elder, willow, eleagnus, elm, mountain ash, birch, apple, raspberry, bean, grass, and clover, while his experiments seem to show that it is as effectual as an insecticide as the more generally used Paris green and London purple.

THE LEEFELD FUMIGATOR.

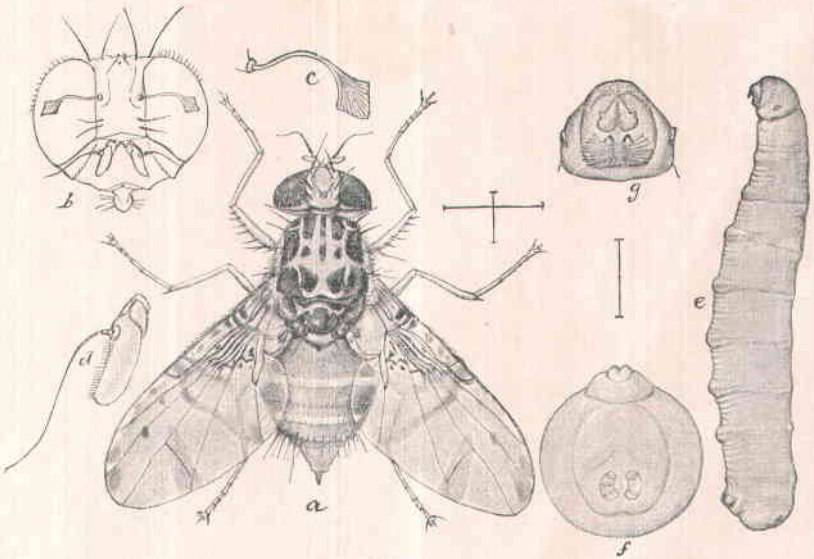


Fig. 1.

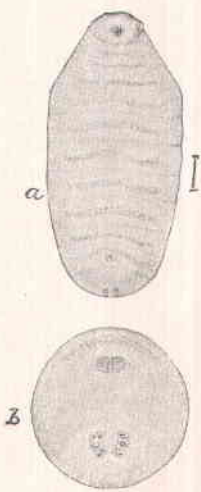


Fig. 2.

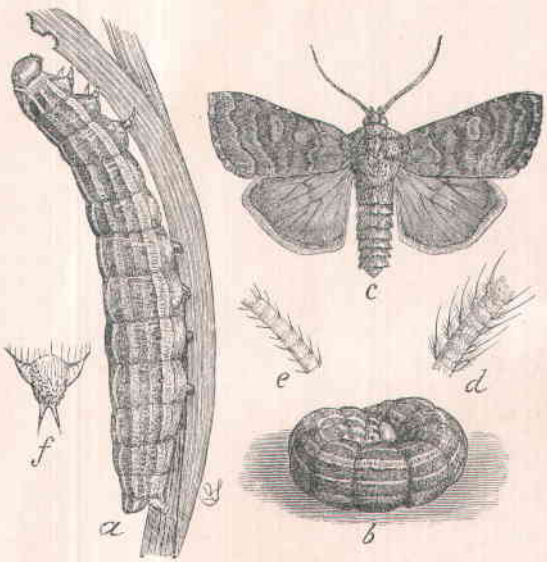


Fig. 3.

CERATITIS CAPITATA AND NEPHELODES VIOLANS.

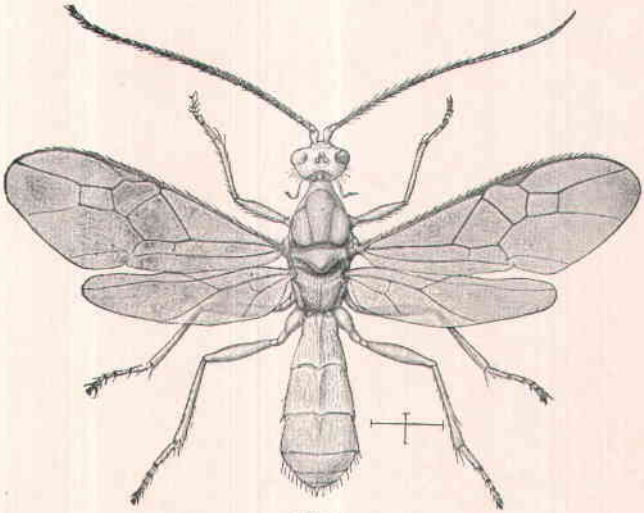


Fig. 1.

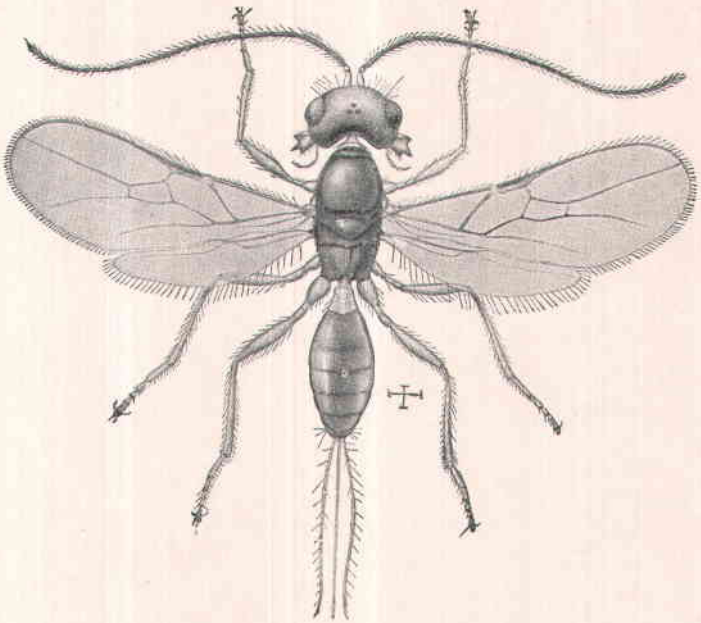


Fig. 2.

PARASITES OF NEPHELODES AND HÆMATOBIA.

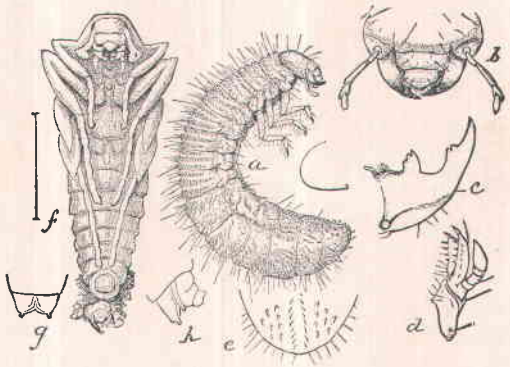


Fig. 1.

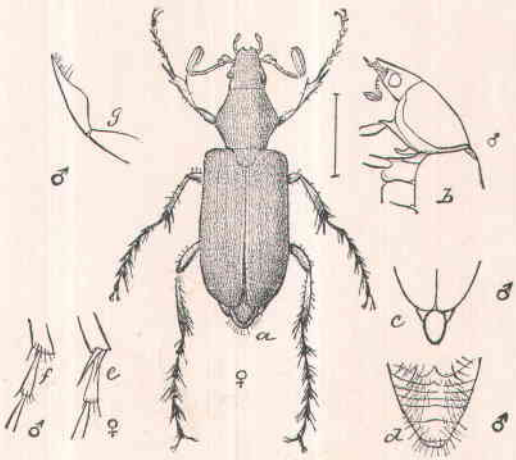


Fig. 2.

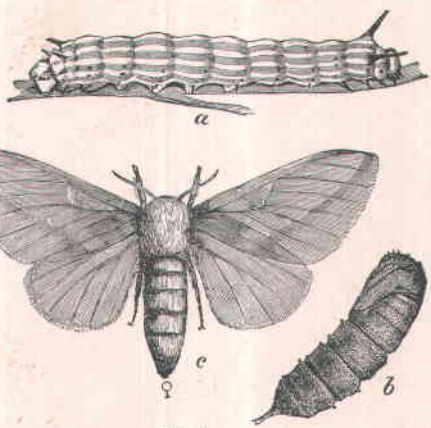


Fig. 3.

THE ROSE CHAFER AND THE GREEN-STRIPED MAPLE WORM.

Report of the Entomologist, U. S. Department of Agriculture, 1890.

THE STATE CAPITOL AT LINCOLN, NEBRASKA, SHOWING TREES DEFOLIATED BY THE GREEN-STRIPED MAPLE WORM.

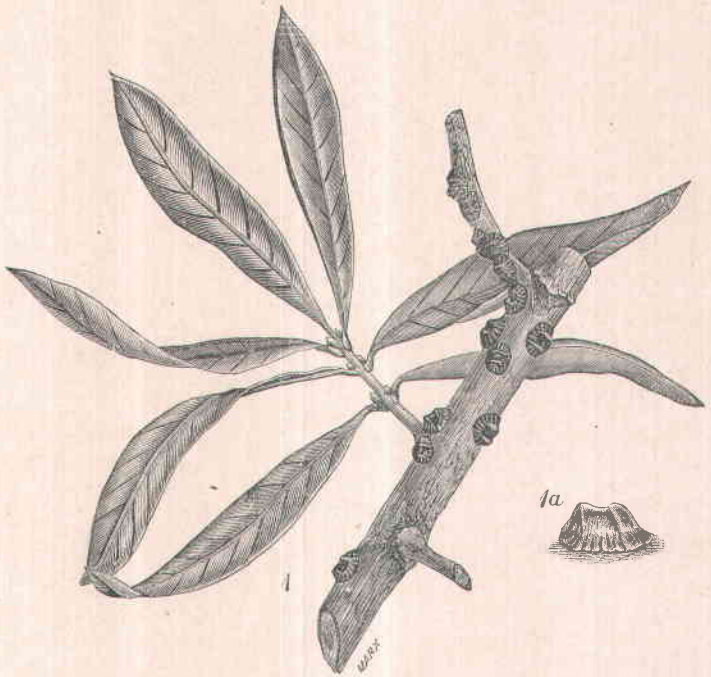


Fig. 1.

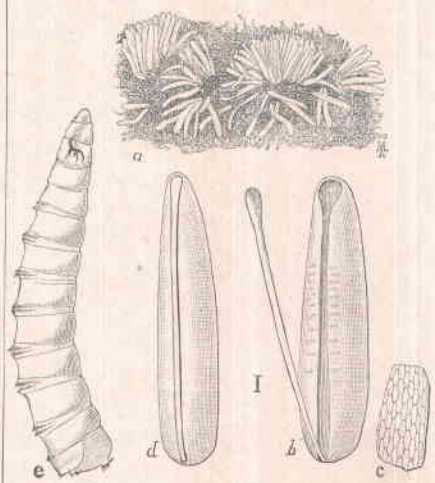


Fig. 2.

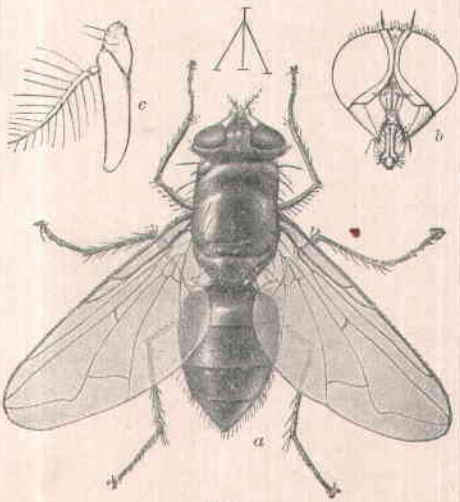


Fig. 3.

THE BLACK SCALE AND LUCILIA CÆSAR.

REPORT OF THE CHIEF OF THE SILK SECTION.

SIR: I have the honor to hand you herewith my second annual report as Chief of the Silk Section. The staff, clerical and operative, has remained as last year, though the correspondence has largely increased, 9,878 letters having been received during the calendar year 1890, as against 5,448 reported for 1889. The scope of the work of the Section has not greatly changed, as will be seen from the report which follows.

Yours respectfully,

PHILIP WALKER,
Chief of the Silk Section.

Hon. J. M. RUSK,
Secretary.

AUTOMATIC SILK REELS.

My report of a year ago told of our work in the direction of perfecting an automatic machine for the reeling of silk, and said that while I believed that substantial progress had been made, still no conclusive results had been reached. I also gave an account of the improvements in preparatory machinery made by Mr. Serrell, in France, and of his temporary abandonment of his experiments for the production of a machine for automatically reeling the silk, properly speaking. I can not learn that his course of action has been changed during the past year. The exhaustion of our funds led me, too, to abandon my mechanical experiments last spring and they have not been renewed during the present fiscal year. The growing conviction that, with existing machinery, silk reeling could be made profitable, if such legislative assistance as has been asked of Congress were accorded, led me to recommend to the Assistant Secretary the temporary suspension of such experiments, and such suspension was authorized by him. It is felt that the establishment of silk reeling in the United States, which we feel sure would follow the legislation mentioned, would soon draw the attention of inventors to this matter, and it seems highly probable that the desired result will, if such circumstances exist, some day be attained and an automatic silk reel be perfected in time to supply any commercial demand that may arise for it.

PROPOSED LEGISLATION FOR THE ENCOURAGEMENT OF SILK CULTURE.

During the last session of Congress, while the Committee on Ways and Means was engaged in the taking of testimony concerning the many industries which the proposed tariff bill would affect, I was instructed by you, at the request of the chairman of the committee, to appear before it and explain the relations which the raising and reeling of silk bear to the more advanced branches of manufacture concerned in the production of this textile. In accordance with these instructions I presented myself at the Capitol on the 6th of January and submitted the facts that I had in my possession. At the request of the committee I again appeared before it early in March to reply to some objections to my suggestions that had been raised by the officers of the Silk Association of America. My remarks on these occasions were published in the report of the evidence taken by the committee (pages 601 and 1349).

My suggestion was that the committee should recommend a duty of $1 per pound on reeled silk imported into the United States. I then believed, as I do now, that such a duty would make it possible to conduct the industry of silk reeling, with profit, in the United States. The representatives of the manufacturers opposed this suggestion most strenuously, saying: First, that silk culture was climatically impossible in our country; second, that neither the duty which I suggested nor any other which I could with any reason expect to have ingrafted in the bill, would make it possible to reel silk with a profit in the United States; and third, that if the duty upon reeled silk which I proposed were levied, it would ruin the interests vested in the manufacture of silk in this country and, in a very short time, close all the mills.

The first assumption I refuted from the published books of the Silk Association itself, and I endeavored to persuade the committee, and I think with success, that I was in quite as good a position to judge of the result of any given protection as a body of gentlemen who made no pretensions to being experts in the industry of silk reeling, and who were confessedly opposed to its establishment in our country. Their third objection, however, that it would ruin the manufacturers, was one which had more effect upon the committee and, while it seems to me that it was as little founded on fact as the other two, I was unable to counteract the impression which it evidently made.

I therefore suggested that, in place of a customs duty, the committee should recommend the granting of a bounty of $1 per pound upon reeled silk produced in the United States from cocoons of American production, and an additional bounty of 7 cents per pound for fresh cocoons of domestic growth. The suggestion was adopted and incorporated in the tariff bill and with it was passed by the House. The Senate Committee on Finance, however, reported adversely upon the section and recommended that it be stricken out, which was done, nor was it restored in conference.

During the past session a bill for the development and encouragement of silk culture in the United States was introduced both in the House (H. R. 137, by Mr. Morrow) and in the Senate (S. 1426, by Senator Mitchell) at the instance of Mr. Joseph Neumann, of California. This bill creates a division of silk culture in this Department and defines the duties of the Secretary of Agriculture in con-

nection therewith. Most important of these duties are the payment of bounties on reeled silk and cocoons produced in the United States and the establishment of sericultural experiment stations for the education of the people in the industries of silk raising and silk reeling and for similar purposes. Another bill (H. R. 8675) was introduced later in the session by Mr. McKenna for the encouragement of silk culture in the State of California. It proposed nothing that would not be included in an intelligent execution of the Neumann bill.

I am heartily in favor of the enactment of some measure which will embody the main features mentioned above. This measure was, you will recollect, referred to you for your opinion by the agricultural committees of the two Houses of Congress, and on your suggesting that it was perhaps inexpedient to report upon it pending action upon the revenue legislation which I have already mentioned, it was, I understand, temporarily laid aside. I now most respectfully and urgently recommend that the committees of the House and Senate be requested to take the matter into further consideration, and after suitable amendment to recommend favorable action upon the bill.

The passage of some measure which shall give a permanent and sure encouragement to silk reelers and growers is, in my estimation, a *sine qua non* to the establishment of silk growing in the United States. After carefully considering the matter I am of the opinion that better results can be obtained by the payment of a bounty for a period of, say ten years, than by the imposition of any duty, however large, upon the manufactured material. The disposition shown by Congress to grant bounties, as evidenced in the case of the sugar industry, will, I hope, lead that body to a favorable consideration of this suggestion now that the question, as applied to the silk industry, is freed from the entanglement of being embodied in a general tariff bill.

Feeling as I do the importance of such legislation to the future of silk culture, and the probability that a failure upon the part of Congress to enact it would be very detrimental to the interests of silk raisers, I deem it proper to present, in as few words as possible, a summary of those reasons which have led me to the belief that under suitable conditions this industry might be made profitable in our country. It has many times been stated in our reports that the inadvisability of attempting silk culture on a large scale had been established for years by the disastrous results of experiments of this nature in France and Italy. The average quantity of eggs placed in incubation in those countries is now about two ounces for each family. Under such circumstances the European farmer is not called upon to employ extra labor, nor are the services of the men of the family required except during the last few days of the rearing. It will be understood that the confining of this work to the women and children necessitates the planting of the mulberry trees in a convenient place near the house, their periodical pruning in such a shape that their leaves can be gathered economically and quickly, and a further condition, perhaps axiomatic, that the persons in charge of the work shall possess such experience as will enable them to perform their labors without serious mistakes or useless friction. It would be an imputation which I should be far from placing upon the women of our farming classes to suggest that they are not as able as their sisters in Europe to become expert silk raisers in a short time.

The work of silk raising occupies from five to six weeks in the spring of the year, beginning upon the budding of the leaves and ending, almost everywhere in this country, before the 1st of July. The labor during the first three weeks of this time is light and it is only during the last age of the worm that the care required becomes constant and the toil fatiguing. An experienced woman, with food at hand in suitable quantities, can easily rear the product of one ounce of silk-worm eggs, with two or three children to pick leaves for her. As I have stated before, assistance might be required of the male portion of the family during the few days prior to the spinning, when the appetite of the worms becomes almost ravenous.

While the natural food of the silk-worm (the mulberry tree) has been planted in comparatively small quantities in the United States, it is a tree of rapid growth and in four years from the seed it can safely be denuded of its leaves without injury to its vitality. It may be planted along the fence lines and thus occupy ground that is so rarely utilized by American farmers. By inquiry I find that the nurserymen, particularly of the West, have large numbers of these trees in stock, which they hold at extremely low prices. In the meantime, while trees are growing, several of our States have an abundant supply of osage orange, the suitability of which to silk raising has long been acknowledged.

We have, then, an industry offered to us which should only be encouraged as one subordinate to the household duties of the women of our farming classes, and from which each should be able to derive a small addition to her annual income by work which lasts but little over a month and which is tedious during a period of not more than ten days. As a return for this labor a woman should harvest not less than 80 pounds of cocoons per ounce of eggs; cocoons which are now worth in the neighborhood of 35 cents per pound (fresh). While she could thus obtain nearly $30 for her otherwise unremunerated labor from the rearing of an ounce of eggs, this amount, by the application of more energy and the assistance of a larger family, might easily be doubled or even trebled by undertaking a larger crop and still without passing the bounds of possibility. This sum in itself may to some seem a small inducement for undertaking the work, but such is not the opinion of those who have become sufficiently expert to be justified in reaching a conclusion and who know the amount of labor involved. It is by its multiplication throughout the innumerable families which would be engaged in the industry, if we produced all of the reeled silk which we consume, that we should add immensely to the aggregate income of the farming classes of the United States.

In my report of a year ago I gave a summary of the total consumption of reeled silk in Europe and the United States, and showed that we were using about one fifth of that consumption in our own country. Our importations had been rapidly increasing in previous years, so that for the fiscal year ending June 30, 1889, we imported "unmanufactured silk" to the value of $19,333,229. The report of the Bureau of Statistics for the present year shows the remarkable increase in this importation of 25 per cent of the entries for 1889, the purchases for the year ending June 30, 1890, having reached $24,331,867.*

*Reeled silk, $23,285,099; waste, $951,910; cocoons, $88,522; silk-worm eggs, $6,336.

About 87 per cent of the value of reeled silk is the worth of the cocoons from which it is produced, and it therefore cost the reelers of the silk imported by us during the last year more than $20,000,000 for the cocoons consumed by them. These cocoons would have been purchased from the farmers, and this amount would have been added to our aggregate agricultural income, had we produced our raw silk instead of buying it of foreign nations.

While the introduction of silk culture into the United States would, like that of any other industry, necessarily be slow, the object to be attained is so great that we should look ahead a decade or two to fully understand its import. The importations of reeled silk into the United States have increased, since 1870, from 583,589 pounds to 5,943,360 pounds, or from a value of $3,017,958 to $23,285,099. This is an increase of more than 900 per cent in weight and 670 per cent in value. The growth has been steady, healthy, and I think I am safe in saying without precedent in any other industry. There is no reason to believe that that growth will not continue to be as phenomenal in the next ten years. I showed in my last report that the consumption of reeled silk by the Western world from 1884 to 1888 increased but 18 per cent, while our own importations increased 60 per cent. If this continues we shall, before many years, be using as much reeled silk as Europe, and, unless our neighbors across the sea reduce their home consumption, our own manufacturers will need to seek new sources of supply. The average declared value of our imports of reeled silk in 1888–'89 was $3.48 per pound and in 1889–'90, $3.90, an increase of 12 per cent, due almost entirely to the short cocoon crop of 1889 in France and Italy. Such being the outlook it seems a penny-wise pound-foolish policy for silk manufacturers not to heartily favor instead of to oppose the proposed bounties; and such persons as may assist, though hesitatingly, in their establishment, will, I feel convinced, find after a lapse of years that they builded better than they knew

DISTRIBUTION OF SILK-WORM EGGS.

During the season of 1890 there were distributed in forty-two States and Territories 800 ounces of eggs, divided into 2,250 lots, an increase of 979. The distribution was as follows:

State or Territory.	Lots.	State or Territory.	Lots.
Alabama	30	Missouri	211
Arizona	4	Nebraska	60
Arkansas	31	New Hampshire	1
California	47	New Jersey	47
Colorado	5	New Mexico	4
Connecticut	15	New York	88
Delaware	10	North Carolina	71
District of Columbia	20	Ohio	177
Florida	55	Oregon	1
Georgia	31	Pennsylvania	154
Illinois	166	Rhode Island	3
Indiana	89	South Carolina	21
Indian Territory	23	South Dakota	10
Iowa	59	Tennessee	25
Kansas	306	Texas	54
Kentucky	32	Utah	12
Louisiana	24	Vermont	3
Maine	1	Virginia	123
Maryland	75	West Virginia	29
Massachusetts	30	Wisconsin	15
Michigan	47		
Minnesota	14	Total	2,250
Mississippi	27		

The distribution comprised the following varieties:

	Ounces.
French:	
Deydier (Cevennes race)	200
Ribaud l'Ange and Gorde (Lower Alps race)	100
Aubin (improved Var race)	100
Forné (Pyrenees race)	100
Italian:	
Mercolini (Marches race)	100
Pucci (Umbrian race)	100
Mari (Ascoli race, two varieties, B and P)	100

Of the Deydier (Cevennes) eggs we can say nothing favorable They were a failure in the hands of even the most careful raisers, and this year this house has been left out in placing our orders. The greater part of our eggs were placed in quarter ounces and in such small lots should have given at least 100 pounds of fresh cocoons per ounce. As a matter of fact there were many raisers who did much better than that, as shown by the following table, but I regret to be obliged to add that it also shows that the average for every race was far below that figure.

Race.	Average crop per quarter ounce.		Largest crop per quarter ounce.	
	Lbs.	*Oz.*	*Lbs.*	*Oz.*
Alps	12	4	35	8
Var	12	0	25	8
Pyrenees	13	2	35	4
Marches	11	4	30	0
Umbrian	11	9	30	6
Ascoli B	9	3	25	2
Ascoli P	10	4	21	0

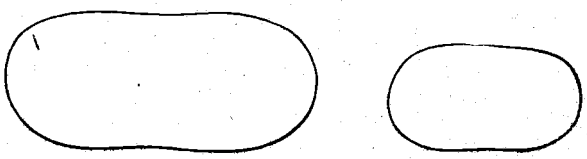
As will be seen from this table the best lot of coccons raised from Umbrian eggs weighed 30 pounds and 6 ounces fresh, which means more than 120 pounds for the ounce of eggs. Such a result is not at all astonishing, and by reference to my report of a year ago it will be seen that it was not as good by 4 pounds to the quarter ounce as we then obtained in our own rearing. It is, however, too much to expect persons with ordinary rearing facilities to make as good a crop as is made in a rearing room that has been prepared with all due regard to ventilation, and where expense has not been spared to make it satisfactory from that point of view. But there is no reason why any silk raiser can not obtain a rendition of 80 pounds of fresh cocoons per ounce, if due care is exercised in following the necessary elementary rules of practical silk growing. Out of the eighty-seven raisers of one-quarter-ounce lots of Umbrian eggs from whom we have received reports, only eight raised more than 20 pounds of cocoons, and I do not scruple to say that insomuch as any raiser fell short of this amount in the total weight of his crop, to that same degree he failed to get the results which he and we had a right to expect from such eggs as were furnished him. What I have said of these Umbrian eggs is equally true of all the other eggs distributed, except the Cevennes.

As has been shown by the table on page 269, 2,250 lots of eggs were distributed last season. This was far in excess of the distribution of 1889 and more than double that of 1888, as shown in former

reports. It is a fact much to be regretted that almost everyone of these applicants had never before applied to us for silk-worm eggs, and, judging from past experience, are not likely to again. Of the upwards of 1,000 raisers who were furnished with eggs in 1889, a little less than 10 per cent had also been applicants in 1888, and of the 2,200 who applied in 1890 but 62 had ever asked us for a similar provision in previous years. Twenty-two of those were supplied in all three of the seasons mentioned.

All of these persons were requested to make some sort of a report to the Department of the result of their work, and all were informed that the Department would purchase their cocoons at a reasonable price. Notwithstanding this, we have received lots from but about 30 per cent of those persons to whom we furnished one quarter of an ounce of eggs. Allowing for the sales to the Kansas State commissioner and other purchasers, it is safe to say that half of the raisers made such complete failures that they had nothing to report upon and nothing to sell.

An examination of the lots received from these small raisers shows us also the difficulty of teaching them the work by the distribution of printed matter. Our pamphlets have been prepared in accordance with the methods adopted by the best silk raisers of Europe, and whenever our experience has shown them to be deficient in certain points, we have upon the printing of a new edition endeavored to bring them more into accord with the needs of our people. One of the points we have called attention to with an especial emphasis is the necessity of feeding the worms liberally and regularly, and still, of the lots which we have received, many show unmistakable evidence of underfeeding and neglect. This is most distinctly emphasized when we receive a lot of cocoons from one raiser which will average as large as Fig. A, annexed, while another raiser, with no more experience and with eggs from the same lot, sends in others of the size indicated in Fig. B.



A B

To the more successful one we pay about 35 cents per pound of fresh cocoons, but the failure is well compensated at 20 cents per pound. It is scarcely necessary to point out the fact that poor quality and consequent low price are almost always the companions of light weight in the crop, so that side by side we have a person who realizes $10 from the cocoons produced from a quarter ounce of eggs, and another who realizes less than $1. In fact we have on several occasions paid less than 10 cents for the cocoons raised by such a grower. All of this emphasizes the fact that if silk culture is to be established in the United States it is absolutely necessary that means should be taken to come into actual contact with our people in order to teach them to raise silk-worms successfully. There seems to be no better way than by the establishment of such stations as are contemplated in the legislative measures that have already been dis-

cussed. Far more general good can be accomplished by the establishment of a few model rearing rooms, where silk-worms can be properly raised every season, in the full view of everybody who chooses to examine into the industry. Thus might be created several centers from which the industry could be spread over such portions of the country as are climatically adapted to it. At present far more harm is being accomplished by assisting would-be silk raisers to make inevitable failures and thus augmenting the number of persons who believe, beyond all power of persuasion, that silk culture is a delusion and a snare for the unwary agriculturalist.

It is not, however, to underfeeding that we must attribute all of the failures that I must report; nor always can it be laid to the door of that inexperience which, I hope, time will correct. All over the South the frosts of the early spring killed the already budding mulberry leaves and much loss has been reported from eggs prematurely hatched before the new growth appeared.

Disease has also made ravages among the silk-worms and much loss is due to this cause. Pébrine has practically been blotted out, and of it and muscardine, again common in Europe, we hear nothing here. The evil comes from flaccidity and, this year, grasserie above all, maladies which are generally attributable to carelessness in some step of the work, in the preparing or caring for the eggs or rearing the worms; but which too often come to the most careful, owing to bad meteorological conditions. Grasserie, which usually attacks but a few worms in a brood, and which, because it is generally unattended by other diseases, is welcomed by Europeans as a harbinger of a good crop, has this year carried off whole broods. This, too, was the case in this Department with the worms fed on osage orange in 1889. An examination of the reports of those who have informed us of the prevalence of this malady does not show that it was common among worms of any particular race, or due to the feeding of any particular food.

THE COCOON CROP OF 1890.

So far as we have been able to ascertain, the following quantities of fresh cocoons were produced in the different States and Territories and purchased at the stations mentioned. Six hundred and eighty-nine lots were purchased at Washington, averaging 16 pounds, and for them we paid an average of 29.6 cents per pound, fresh (about 89 cents per pound, dry).

State or Territory	Washington.		Philadelphia.		Peabody.		Total.	
	Lbs.	*Oz.*	*Lbs.*	*Oz.*	*Lbs.*	*Oz.*	*Lbs.*	*Oz.*
Alabama	68	4					68	4
Arkansas				3				3
California	786	0	61	6			847	6
Connecticut	50	8	5	0			55	8
Delaware	67	2	68	3			135	5
District of Columbia	94	10					94	10
Florida	30	0	204	8			234	8
Georgia	92	1					92	1
Illinois	915	5	111	8			1,026	13
Indiana	437	10	161	11			599	5
Indian Territory	1	8					1	8
Iowa	265	2	18	9			283	11
Kansas	713	10	24	7	3,000	0	3,738	1
Kentucky	114	6					114	6

State or Territory.	Washington.		Philadelphia.		Peabody.		Total.	
	Lbs.	*Oz.*	*Lbs.*	*Oz.*	*Lbs.*	*Oz.*	*Lbs.*	*Oz.*
Louisiana	22	8	7	9			30	1
Maryland	201	0	67	6			268	6
Massachusetts	141	12	2	7			144	3
Michigan	199	2	109	10			308	12
Minnesota	113	4					113	4
Mississippi	178	11					178	11
Missouri	1,573	14	1,587	13			3,161	11
Nebraska	433	12	1	15			435	11
New Jersey	87	6	3	11			91	1
New York	134	4	30	12			165	0
North Carolina	302	7					302	7
Ohio	1,421	10	280	5			1,701	15
Oregon	12	12					12	12
Pennsylvania	395	4	332	2			727	6
Rhode Island	14	0					14	0
South Carolina	28	14	12	2			41	0
South Dakota	93	2					93	2
Tennessee	72	0					72	0
Texas	339	12	6	15			346	11
Utah	890	7					890	7
Vermont	9	0					9	0
Virginia	378	2	19	3			397	5
West Virginia	60	12	17	9			78	5
Wisconsin	44	4	35	1			79	5
Total	10,784	0	3,169	15	3,000	0	16,953	15

VARIETIES OF COCOONS.

Greatly to my regret, a failure to prepare the illustrations in time, prevented my inserting in my annual report for 1889 an account of some of the typical races of cocoons raised in Europe. As I there stated the great bulk of French eggs is produced in the department of the Var. The typical race of that department is large and of coarse texture (Plate I, Fig. 1), more so in fact than is found profitable by silk reelers who prefer to go to neither extreme, either in size or texture. As a result this race has largely been used in crossing. In the Oriental Pyrenees we find the small, fine Roussillon race (Plate I, Fig. 3), also rarely reared commercially. The crossing of these two, however, produces a robust, healthy variety, of good rendition and pleasing to the reelers. It is shown at Plate I, Fig. 2, between the other two, so as to be easy of comparison.

The improvement of races is also frequently accomplished by a change of climate. Such a change has produced from the coarser Var a cocoon like that shown at Plate II, Fig. 1, when reproduced in the Oriental Pyrenees. The Cevennes race, again, is of the desired mean, both in size and texture. It is shown at Plate II, Fig. 2. The effect of climate is perhaps most strongly shown in the white Bagdad cocoons illustrated at Plate III, Figs. 3 and 4. The former was obtained from M. Marcy, of Grasse, Var, and had been raised by him but one season since the arrival of the original eggs from the Levant. The race shown in Fig. 4 had been several times reproduced in France, though of the same origin as the first mentioned. It will be seen how a change of climate and careful selection have toned down the rugosity of its surface and brought its shape to that more ordinarily found among European races.

Early in the spring, long before the mulberry leaves were budded in Washington, there reached us through the State Department, from the consul general at Teheran, two lots of silk-worm eggs, already hatching. They had been obtained by him from Sabzawar (Persia) and Herat (Afghanistan). They were raised as well as possible, first on lettuce, and later on mulberry leaves, received daily by mail from Florida. They did fairly well under the circumstances, the two races showing no difference in the cocoons. These were in each case deep yellow and white mixed and were covered with a large quantity of floss. The sizes of the cocoon with and without floss are so different that I have thought it interesting to show them. They are illustrated at figures 1 and 2 of Plate III. The pointed ends, it will be noticed, are in great contrast with the ordinary rounded cocoon of Europe.

A few years ago there were obtained by M. Natalis Rondot, from Persia, two races called the Shazevar, green and yellow. M. Rondot considers them, as nearly as possible, the primitive races of the country, as are the White Cina of China. When received they showed a good deal of pébrine, and in fact eggs of this race that we obtained in 1889 from Padua did not give a single cocoon. We were more successful, however, in 1890, receiving a pinch each of yellow and of green eggs which did excellently. The cocoons are very large, as shown in Plate II, Fig. 3. We have saved some healthy eggs of each race and made some experiments in crossing, upon which I shall report next year.

Another type of cocoon is shown at Plate III, Fig. 5. It is of Cyprian origin, raised one year in Italy and one in Washington. The cocoons are proportionately longer than most well-known races, pointed at the end and of rather coarse texture.

All of the cocoons shown are of the natural size.

THE PRUNING OF MULBERRY TREES.

In my annual report for 1887 I described the process of raising mulberry trees as practiced in the Cattaneo nurseries, in Italy. It will be seen from that account and from the two plates which accompany it, that the tree described is one of the kind called "standard," that is to say that it is allowed to branch at a point 6 feet from the ground. The main object of cultivating a tree as high as this is to permit of another crop being planted in the orchard, and it is customary in Italy so to plant corn or wheat, leaving a passage along each row of trees so that the leaves can be picked without injuring the surrounding grain. The picking of leaves from a tree like this requires the use of a double ladder, and this, among American women, will alone operate to the disadvantage of this style of pruning.

We have, on the Department grounds, a row of dwarf mulberry trees such as is shown in Plate IV of this report. The tree there shown was first made to fork at 1 foot from the ground, a second time at about 6 inches higher, and still a third time 6 inches higher yet. It will require but one more "crowning," as this pruning is called, to get the tree into proper shape; then all that will be necessary will be to cut back the shoots once in two years in order to obtain a suitable supply of leaves. As the tree was photographed its foliage (Fig. 2) weighed 6 pounds. It was 7 feet high and 8 feet across the branches. To allow for suitable growth these trees should be

planted about 10 feet apart and make an excellent form for setting along a fence line.

Another manner of pruning is shown in Plates IV and V, copied from photographs of a half-standard tree. This tree is of the same age as the other but has been pruned but twice. It is 3 feet from the ground to the lower fork, and, as was the case with the dwarf, 6 inches more to the upper one. The tree was 7 feet across and 9 feet high and might be planted in the same manner as the other. It furnished 14 pounds of leaves.

It may be well to add that the foliage of both of these trees will probably be three times as great next year as it was last, and further, that the trees were of the seedling white variety (*Morus alba*), of which the leaves are small and much indented. A rose mulberry tree of the same age and size would probably furnish more than twice as great a weight of leaves, and these leaves in turn would give half as much more silk per hundred pounds as those of the seedling. Assuming these facts to be true, as they essentially are, rose mulberry trees of the form described above and at the age when they should be definitely formed (that is to say four years old) would give for the dwarf 36 pounds of leaves, and for the half-standard 84 pounds. From this it can be estimated how many trees would be necessary to furnish the foliage needed to feed the worms coming from an ounce of eggs, it being remembered that it takes 1,600 pounds for that purpose.

It will be recalled that these figures refer to four-year-old trees which are really about as small as are usually commercially employed. The trees grow rapidly from that age, and assuming the weight of leaves which such a tree will give to be 100 per cent, the quantity of foliage will augment, according to Gobin,* in somewhat the following ratio.

Age.	Per cent.	Age.	Per cent.
4 years old	100	14 years old	680
5 years old	157	15 years old	741
6 years old	225	16 years old	777
7 years old	287	17 years old	805
8 years old	373	18 years old	827
9 years old	423	19 years old	846
10 years old	463	20 years old	861
11 years old	566	21 years old	868
12 years old	605	22 years old	877
13 years old	658		

* Muriers et Vers à Soie, Paris, 1874, p. 93.

DESCRIPTIONS OF PLATES.

PLATE I,	Fig. 1.	Cocoons of the large Var race (France).
	Fig. 2.	Cocoons of Var crossed with Roussillon.
	Fig. 3.	Cocoons of the Rousillon race (France).
PLATE II,	Fig. 1.	Cocoons of the Var race reproduced in the Oriental Pyrenees (France).
	Fig. 2.	Cocoons of the Cevennes race (France).
	Fig. 3.	Cocoons of the yellow Shazevar race (Persia).
PLATE III,	Fig. 1.	Cocoons of the Sabzewar race (Persia) with floss.
	Fig. 2.	The same with the floss removed.
	Fig. 3.	Cocoons of the white Bagdad race raised one season in France.
	Fig. 4.	The same raised several seasons in France.
	Fig. 5.	Cocoon of a race from Cyprus, raised one season in Italy and one in Washington.
PLATE IV,	Fig. 1.	Half-standard mulberry tree before pruning.
	Fig. 2.	The same after pruning.
PLATE V,	———	Half-standard mulberry tree with foliage.
PLATE VI,	Fig. 1.	Dwarf mulberry tree with foliage.
	Fig. 2.	The same without foliage and before pruning.
	Fig. 3.	The same after pruning.

Fig. 1. LARGE VAR.

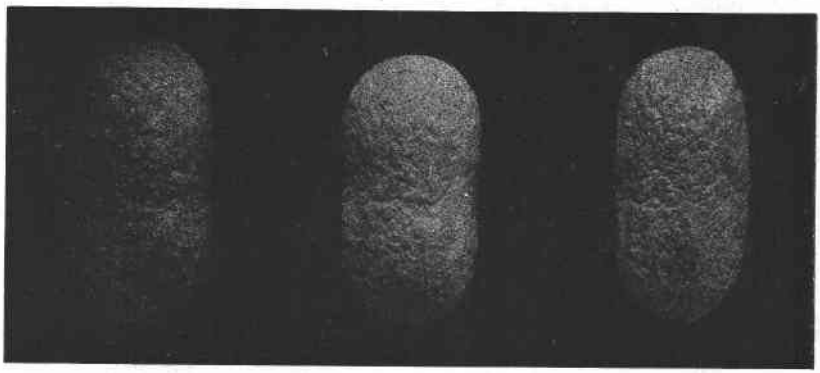


Fig. 2. VAR AND ROUSILLON CROSSED.

Fig. 3. ROUSILLON.

VARIOUS RACES OF COCOONS.

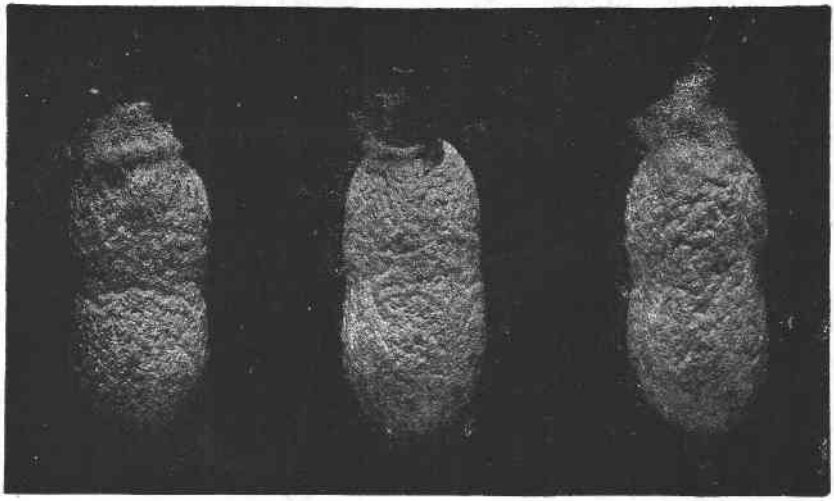


Fig. 1. VAR REPRODUCED IN THE ORIENTAL PYRENEES.

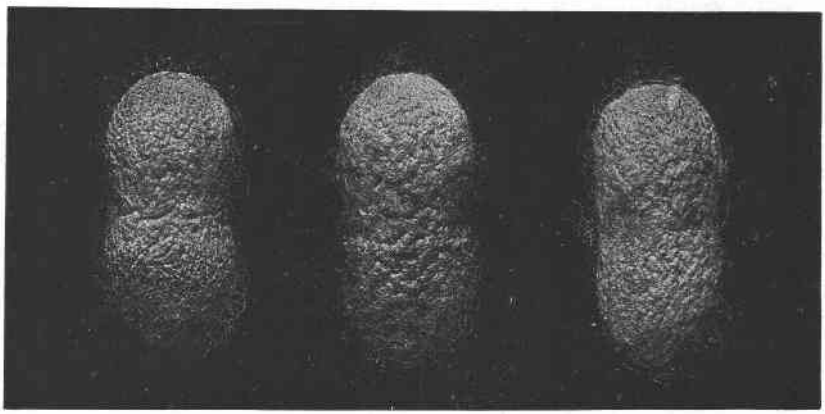


Fig. 2. CEVENNES.

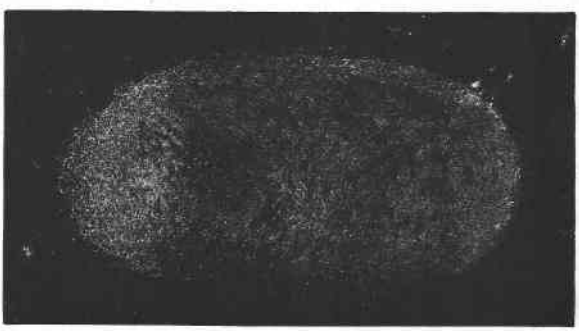


Fig. 3. PERSIAN RACE, "SCHAZEVAR."

VARIOUS RACES OF COCOONS.

Fig. 1.

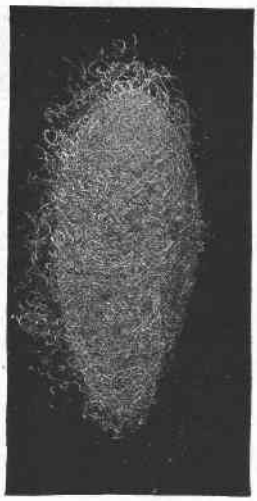


Fig. 2.

Fig. 3.

Fig. 4.

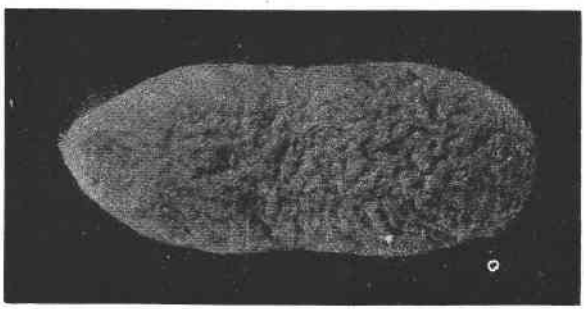


Fig. 5.

VARIOUS RACES OF COCOONS.

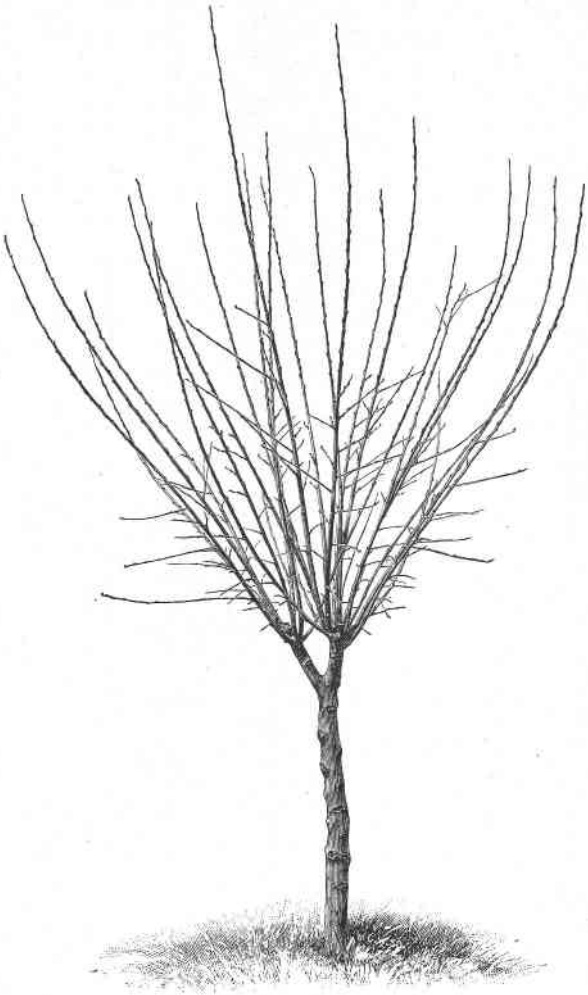
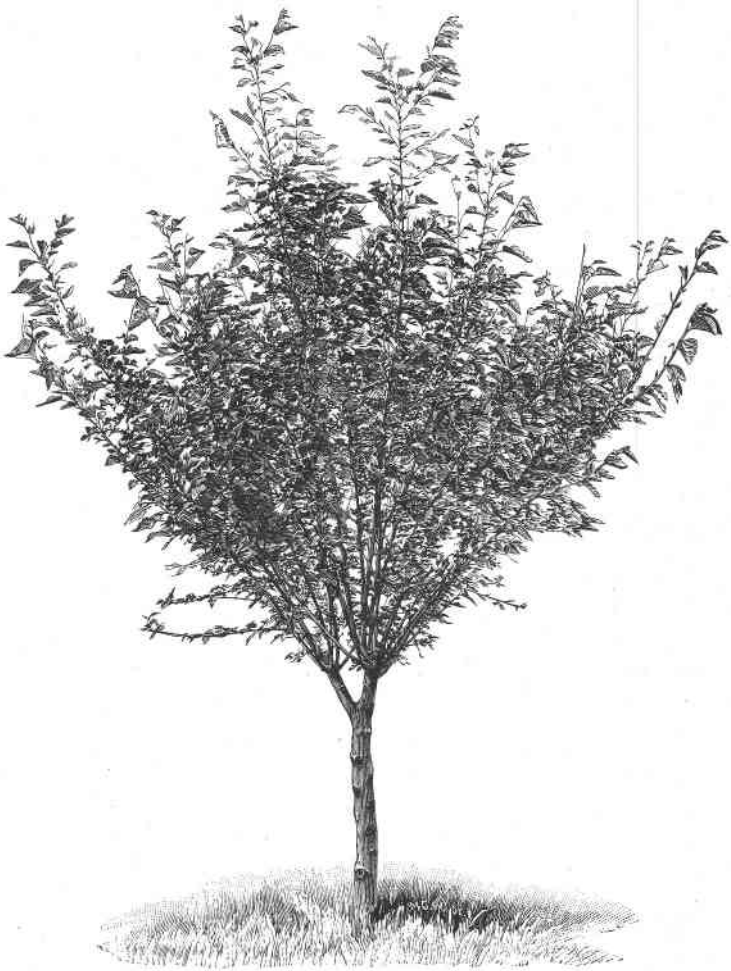


Fig. 1.

Fig. 2.

THE PRUNING OF MULBERRY TREES. HALF-STANDARD TREE.



HALF-STANDARD MULBERRY TREE.

Fig. 1.

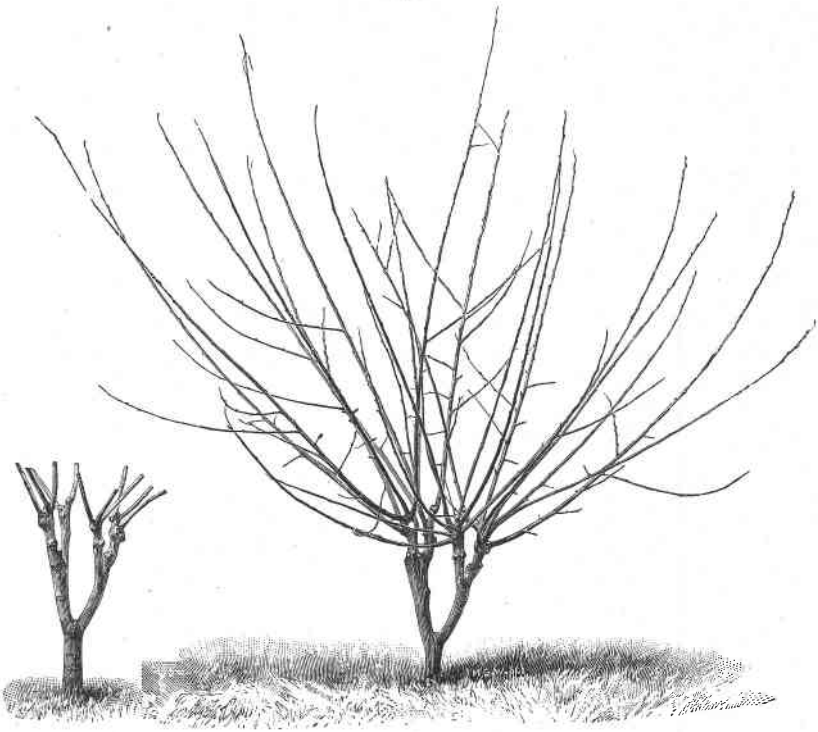


Fig. 2.

Fig. 3.

PRUNING OF MULBERRY TREES, DWARF.

REPORT OF THE ORNITHOLOGIST AND MAMMALOGIST.

SIR: I have the honor to submit herewith my fifth annual report of the doings of the Division of Economic Ornithology and Mammalogy, covering the year 1890. It consists of two principal parts or sections in accordance with the two lines of work carried on by the Division—the one, a study of the *economic relations* of mammals and birds which are beneficial or harmful from a directly economic standpoint; the other, a study of the *geographic distribution of species.*

As stated in my last report, the office force of the Division is wholly insufficient for the rapidly increasing demands of the investigations in hand, and the mere routine work has already outgrown the means at command for its proper accomplishment. During the year 1890 about four thousand letters were written, copied, indexed, and mailed, and several thousand circulars and schedules were distributed. During the same period the number of letters received was more than five thousand, and more than half of these were accompanied by schedules, lists, reports, or other records of observations, all of which were examined, indorsed, jacketed, and either filed for future reference or at once utilized in studies already in progress. Other routine work has consisted in attending to the needs of field agents, in identifying specimens, comparing and correcting proof, preparing and revising card lists of correspondents, filing certain classes of reports received, typewriting franks for the distribution of documents to American and foreign correspondents, compiling a reference list of publications useful in the regular work of the Division, preparing colored diagrams or maps in connection with the work on geographic distribution, and miscellaneous work.

It is gratifying to record the fact that the restriction referred to in my last report as seriously affecting the scope of the work, has been removed by Congress, in obedience to your urgent recommendation, and that the Division is now in effect a biological survey, it having been authorized to undertake a comprehensive investigation of the geographic distribution of animals and plants.

I beg to call your attention to the inferior colored illustrations contained in the last annual report and in other publications of the Division. The originals from which these pictures were reproduced are of the highest quality, while the prints in the reports are the cheapest chromos—coarse, dauby, and differing widely in different copies. Such figures are discreditable to the Department and a disgrace to the National Government. Unless it is possible to obtain illustrations that are at least respectable it is better to do without them altogether.

Respectfully,

C. HART MERRIAM,
Chief of Division of Ornithology and Mammalogy.

Hon. J. M. RUSK,
Secretary.

WORK OF THE YEAR.

SECTION OF GEOGRAPHIC DISTRIBUTION.

The work accomplished in the section of geographic distribution may be conveniently summarized under two heads, namely, (1) office work, and (2) field work.

(1) *Office work.*—The office work has consisted largely in collecting and tabulating records of the occurrence of certain species of mammals, birds, reptiles, and plants for the purpose of mapping their distribution; in working up the results of the field work carried on by the Division; in the care and arrangement of the material sent in by field agents and others; in the identification of specimens sent to the Department for that purpose, and in the preparation and publication of reports based on the investigations of the Division.

In mapping the distribution of species an obstacle is frequently encountered in the unsettled status of the species themselves, for it is impossible to map the distribution of animals which have not been named, and whose relationships are unknown. In the light of the large series of specimens collected by the Division in regions heretofore unvisited by naturalists, many groups require thorough revision before the species can be correctly named. The results of these critical studies appear in NORTH AMERICAN FAUNA, the publication containing the results of the scientific work of the Division. Two numbers of NORTH AMERICAN FAUNA (Nos. 3 and 4) have been prepared and issued during the year, the first comprising the results of a biological survey of the San Francisco Mountain region and desert of the Little Colorado, in Arizona; the second containing descriptions of a number of new species of North American mammals.

(2) *Field work.*—Field work has been carried on during the year in parts of Minnesota, Nebraska, Wyoming, Utah, Nevada, Idaho, Oregon, Washington, California, Texas, Mississippi, and Alabama, and several thousand specimens, including many species new to science, have been secured and now form a part of the national collections at Washington.

SECTION OF ECONOMIC RELATIONS.

The economic work of the Division, that devoted to the study of species directly injurious or beneficial to agriculture, has been confined mainly to investigations connected with the preparation of the four bulletins already announced, namely:

(1) *An illustrated bulletin on hawks and owls.*—This bulletin is now completed and will be published as soon as funds are available for the purpose. In its preparation the stomach contents of about 2,500 hawks and owls, representing 45 species, have been examined and the results tabulated; and to the mass of facts thus obtained the published observations of reliable naturalists throughout America have been added. The conclusions based on the study of this vast amount of material are irresistible. It is shown beyond question that the American hawks and owls, excepting the few species which habitually prey upon domesticated fowls or beneficial birds, are of great value to the farmer, destroying rats, mice, gophers, squirrels, and insects.

(2) *Bulletin on the gophers of the Mississippi Valley.*—Work on this bulletin has been continued during the year, and much valuabl-

information has been secured concerning the distribution and ravages of the several species.

(3) *Bulletin on crows.*—Work on this report has been continued, but it is deemed inexpedient to publish the result until additional material has been obtained. It is believed that some disputed points in the history of crows have been settled finally, but others need further study and experiment. The harm done to newly planted corn by crows is counterbalanced in some degree by their services as scavengers, and in the destruction of field mice and insects; moreover, comparatively inexpensive methods of protection have been found for this crop. But when the destruction of chickens, young birds, and eggs is added to the havoc wrought to grain and fruit during the summer and autumn, the account refuses to balance without additional evidence in favor of the crow. Such evidence *may* be found in the destruction of harmful insects; but in order to prove or disprove this claim, as well as to determine the extent of injury to the young and eggs of valuable birds, it is necessary to examine the stomachs of numerous crows killed under favorable circumstances during the spring and summer. One thousand stomachs (two thousand would be better) from farming lands in a dozen different States would make it possible to settle with comparative accuracy most of the disputed points, but such stomachs are not easily obtained. In response to an appeal in the Annual Report of 1888, a few offers of assistance were received, and eventually a few stomachs, but in almost every case the volunteer assistants found it much more difficult than anticipated to kill crows in warm weather, and less than one hundred crow stomachs in all have been received. A few of these were empty, and others were taken in cold weather, so that only two or three dozen contain evidence pertinent to the investigation. It is hoped that during the coming season farmers and others interested in the matter will coöperate with the Division in order to secure a sufficient number of stomachs for the completion of this work. Anyone willing to assist will be furnished directions on application to the Division.

The insect remains from the stomachs of fifty crows were submitted to Prof. C. V. Riley, Entomologist of the Department, for examination, and his report on them has been received.

(4) *Bulletin on crow blackbirds.*—It is intended to make this bulletin as thorough and comprehensive as that on the crow, and the work is being carried out in the same manner. Crow blackbirds are guilty of some of the same crimes as crows, but also have habits peculiar to themselves. As they nest in communities and may be found in flocks at all seasons in some parts of the United States there is less difficulty in collecting them, and the Division now has on hand about five hundred of their stomachs, many of which have been examined.

In connection with the three bird bulletins mentioned above, 1,017 stomachs have been examined since January 1, 1889, while about 250 more, mainly those of bobolinks, meadow-larks, bluebirds, and woodpeckers, have been examined in compliance with special requests for information as to the food of these particular species.

The bobolink stomachs were examined with a view to determining the summer food, and the results showed beyond question that during the breeding season these birds are not only harmless but decidedly beneficial. All the stomachs contained insects in abundance, and many of them larvæ injurious to grass lands.

The investigation of the food of the meadow-lark (*Sturnella magna*)

was undertaken in response to inquiries concerning its alleged fondness for clover seed; hence stomachs collected in autumn only were examined. These were thirty in number and were collected at various places in North Carolina, New York, Pennsylvania, and Tennessee during the months of October and November. At least 99 per cent of the contents of all these stomachs consisted of insects and only one contained no insects. The remaining 29 contained 25 caterpillars, 57 grasshoppers, and more than 80 beetles. About 100 seeds were found, of which 15 were clover, 13 wheat, oats, and corn, and the rest grass and weed seeds. Hence it is evident that the Meadowlark is one of the birds which the farmer should protect.

In connection with these food investigations the value of the reference collection of seeds has been demonstrated constantly. As yet it contains only about 240 genera of seeds, one third of which were added during the year. It still lacks many common species of the eastern United States on which some of our birds feed.

Since January 1 the collection of stomachs has been increased by 1,096, the total number now on hand being 11,812. During the same time 1,265 stomachs have been examined.

A biological clerk was added to the force of the Division in August and much better progress is now being made in the determination of the food contents of bird stomachs.

COLLECTIONS OF THE DIVISION.

The collection begun by the Division a little more than a year and a half ago has made gratifying progress, now numbering upwards of 4,000 specimens of mammals, 1,300 birds, and 500 reptiles and batrachians.

IDENTIFICATION OF SPECIMENS.

As stated in previous reports, the Division is prepared to identify and return specimens of mammals and birds received for that purpose. Such specimens may be sent by mail post free in packages to which return penalty envelopes are attached. The number of specimens received for identification from field agents and others during the past year aggregated more than 5,500. Notwithstanding the fact that much labor is involved in the determination of these specimens, and that their numbers are increasing year by year, every effort is made to give the work the attention its importance deserved.

SEED PLANTING BY BIRDS.

By WALTER B. BARROWS, *Assistant Ornithologist.*

For centuries the fact has been recognized that birds are instrumental in distributing the seeds of some plants, and that they are, to use a hackneyed expression, one of the agencies in forest rotation and in resurfacing with vegetation tracts swept bare by wind, water, fire, or the hand of man.

Examples of this kind of work by birds have been cited with some care and detail by a few good naturalists, while sweeping generalizations and extraordinary applications have been made by writers on popular natural history.

It is not for me, at least at the present time, to commend or criti-

cise either class, but with the hope of adding a few grains of solid truth to the common fund of knowledge, and particularly with the desire of awakening interest in facts which almost daily pass unnoticed by farmers, sportsmen, and field naturalists, I have brought together a few of the notes made in connection with the field work and routine examinations of bird stomachs in the U. S. Department of Agriculture.

The smaller land birds of a country, especially those supposed to be beneficial or harmful, are commonly divided into two great groups, insect-eaters and seed-eaters, and this division, though strongly artificial, still has some warrant in fact. When legislators wish to appear extremely exact without specifying each bird by name, they add another category, that of song-birds, and thus many of our State laws aim to protect song and insectivorous birds, while the seed-eaters, so-called, are denied any protection, or get what safety they can from alliance with "song-birds."

As a rule, however, the seed-eaters are not the seed-planters; on the contrary, the insectivorous birds more often sow seeds than the true seed-eaters, while the song-birds, particularly the thrushes and their allies, are still busier seed-planters. These statements, at first sight so contradictory, will become intelligible perhaps under the reminder that seeds, *as such*, are eaten for the kernel or embryo which they contain, and the grinding and digestion of this necessarily destroys the seed. Many fruits and so-called berries on the other hand, are eaten solely for the nourishing matter surrounding or attached to the seeds, and in most such cases the seed escapes destruction and is dropped either by ejection or rejection at a distance from the parent plant. In other words, seeds which *simply contain* nourishment are eaten and destroyed, while seeds which *are contained in nourishment* are eaten and survive.

Thus it happens that the armies of sparrows, finches, and similar birds in winter eat and destroy tons of grass seed and weed seed, while the same birds in summer and autumn may eat bushels of blueberries, huckleberries, elderberries, raspberries, strawberries, and similar fruits, and distribute their unharmed seeds over thousands of acres, which otherwise might never support a growth of these species.

But there is every reason to believe that the birds just mentioned do not eat, even at the height of the berry season, one quarter as many berries as some of the so-called insectivorous birds, such for example as the thrushes, catbird, mocking-bird, orioles, wax-wing, vireos, and woodpeckers. As a matter of fact, however, that which is definitely known on this subject is so little in comparison with what easily might be learned, that we can scarcely do more than call attention to our astounding ignorance of the food of some of our common birds.

The few berries already mentioned are such as ripen in summer or early autumn, and without exception disappear before cold weather sets in. Numerous other fruits, however, ripen during autumn and many of them clinging to the twigs throughout a considerable part of the winter afford a food supply for numerous late migrants and winter residents. Among such fruits may be mentioned the berries of the holly (*Ilex*), cat-briar (*Smilax*), bitter-sweet (*Celastrus*), sour-gum (*Nyssa*), flowering dogwood (*Cornus*), mountain ash and chokeberry (*Pyrus*), hackberry (*Celtis*), bayberry (*Myrica*), and the various sumachs and other species of the genus

Rhus. Anything like complete lists of the fruits eaten by birds, or of the birds which eat the different fruits would be tedious in the extreme, and moreover it is extremely improbable that any single individual or institution in this country possesses the data for making such lists.

The collection of stomachs in the Ornithological Division of the Department of Agriculture now numbers nearly 12,000, and is daily increasing, yet in this large collection very few species indeed are represented by a fair number of stomachs taken at all seasons of the year. Recently a question arose as to the food of the Upland Plover (*Bartramia*), and the collection being appealed to showed only a single stomach. A short time ago, after taking about one hundred seeds of five different kinds from less than a dozen stomachs of the Yellow-rumped Warbler (*Dendroica coronata*), I turned to compare these with the stomach contents of the Palm Warbler (*Dendroica palmarum hypochrysea*), and was disappointed to find but two stomachs of the latter species taken in autumn. All this is through no fault of the Division of Ornithology, but simply results from the size of the field. Several hundred species of birds are common in one part or another of our great country, and it is not to be expected that any collection can show a dozen stomachs of each species for each month of the year.

But although we may not at present list either the seeds that are eaten or the birds that eat them, we may get some useful hints and perhaps draw some conclusions from the facts which have been observed already. It has been stated that many insectivorous birds eat fruit. One of the most noteworthy examples of this kind is seen in the case of swallows, birds usually considered to be strictly insectivorous. I am free to confess that ten years ago I should have scouted the idea that swallows ate anything but insects, and had the farmers and fishermen along our Atlantic coast asserted then that swallows ate bayberries by the thousand in August, just before leaving for the South, in all probability I should not have given the matter a second thought, although the proof was directly at hand. Nevertheless it is now certain that several species of our swallows, notably the white-bellied, bank, and barn swallows, do feed very largely on the bayberry or waxberry (*Myrica cerifera*) wherever it is found; and my only regret is that I was so blind years ago as not to see that the swallows hovering by thousands among the bayberry bushes were greedily eating the berries instead of picking up flies as I then supposed. My eyes were first opened to this habit of the swallows by Dr. A. K. Fisher, and to the same person I am indebted for several similar hints, among others for notes relating to the fruit-eating habits of the vireos. Having seen a kingbird (*Tyrannus*) gorging himself with cultivated cherries about six years ago, my faith in purely insectivorous birds was considerably shaken, and the revelation in regard to swallows and bayberries completed its overthrow.

It may be remembered that the annual report of the Ornithologist of the Department of Agriculture for the year 1888 contained some statements in regard to crows eating seeds of poison ivy, statements for which the present writer was responsible. Among these was the remark that the excrement from a crow roost at Arlington Cemetery contained a large number of seeds of poison *Rhus*. Mr. Otto Widmann, of St. Louis, wrote me soon after stating that in his own experience with crows he had always found the seeds in the pellets or castings ejected from the mouth, never in the droppings.

This led to further investigations, and although in one or two instances seeds were found in the intestines of crows, it was found that the great majority of seeds, with much gravel and other indigestible matter, were ejected by the mouth after the nutritious matter had been digested.

Two living and healthy crows were procured, and were subjected to careful experiment for several months, and it was speedily shown that they were able to disgorge at will anything digestible or indigestible, or in any way distasteful. As for poison ivy berries one crow swallowed over eighty in a few moments, and within forty minutes ejected the seeds by the mouth, all cleaned, polished, and enveloped in a thick coating of sand. Whenever grain or seeds were fed to these birds they invariably swallowed large quantities of sand after it, scooping it up, a teaspoonful or more at a time, and washing it down with repeated swallows of water.

It seems hardly necessary to say that any bird who treats berries or stone fruits in this way, undoubtedly distributes the seeds under such conditions that many are sure to grow. In order to give some idea of the number of seeds thus distributed by crows alone, it was stated in the Annual Report for 1888 that a single pound of dried deposit taken from the Arlington roost contained by actual count 1,041 seeds of poison ivy (*Rhus toxicodendron*), 341 seeds of poison sumach (*Rhus venenata*), 3,271 seeds of other sumachs, 95 seeds of Virginia juniper, 10 seeds of flowering dogwood, and 6 seeds of sourgum; a total of 4,764 seeds. The material, which covered about 4 square feet, was taken at random from above the layer of leaves and represented the average deposit on the roost at that time. As the roost covered upwards of 15 acres this would give a total in round numbers of 778 million seeds, or enough to plant more than 1,150 acres as closely as wheat is sown.

By actual experiment it was shown that at least 90 per cent of the poison seeds found at the roost were entirely uninjured, and under favorable conditions would grow. Of course the conditions were *not* favorable at the roost, and most if not all the seeds would perish, but it should be remembered that on an average the crows are at the roost only about one half the time during the winter, thus spending twelve hours of daylight scattered over the surrounding country, and twelve hours more at the roost. In view of what has been said about the rapidity of digestion in crows, it seems certain that as many seeds would be scattered away from as at the roost and many of these would be sure to grow.

It seemed perfectly natural to conclude that crows did much harm by thus sowing poisonous seeds; but while subsequent investigation does not lessen our estimate of the harm thus done, it appears that if we condemn the crow for this we must also condemn many other birds. How many we do not know, but we have found large numbers of seeds of poison sumach in the stomachs of the bluebird (*Sialia sialis*), Yellow-rumped Warbler (*Dendroica coronata*), Flicker (*Colaptes auratus*), Downy Woodpecker (*Dryobates pubescens*), Hairy Woodpecker (*D. villosus*), Pileated Woodpecker (*Ceophlœus pileatus*), and Bob White (*Colinus virginianus*), and there is little doubt that they will be found in the stomachs of many other birds when a systematic search is made. At the same time it is unsafe to predict it except in a very few cases.

Although the common crow undoubtedly is very fond of poison *Rhus* berries, the fish crow (*C. ossifragus*) appears to avoid them,

since the examination of twenty-six stomachs of this species failed to show even a trace of poison *Rhus*. This is the more remarkable because the stomachs did contain the seeds of many other fruits (including seeds of harmless sumachs), and it has been observed that fish crows seem to be much heartier fruit eaters than the common crows. Nevertheless the number of stomachs examined is far too small to base any argument upon, and it will not be strange if all the stomachs examined hereafter be found to contain large quantities of these seeds.

Similarly, it was at first believed that all the woodpeckers would be found to eat these poison berries in autumn and winter, but the recent examination of thirty stomachs of the yellow-bellied woodpecker (*Sphyrapicus*) failed to give any proof of it in this species, although the seeds of cherry, grape, sour-gum, and flowering dogwood were abundant.

One fact perhaps is worthy of note in connection with the fruit-eating habits of birds. It has been assumed, and in some cases undoubtedly has been proved, that the bright colors of fruits have been developed or acquired because of their usefulness in attracting the attention of animals which feed upon them. Both Darwin and Wallace speak particularly of red, yellow, and white fruits in relation to this use. In the case of the genus *Rhus*, we have common, harmless species which bear very conspicuous, large, compact bunches of red berries, which certainly are edible, and which yet contain comparatively little nourishment. The berries of the poison species of *Rhus*, on the contrary, are greenish or yellowish-white, mostly in small and inconspicuous clusters, yet they contain a relatively larger amount of nourishment than the harmless species. Berries of all the species are sought for and eaten by birds of many species, and the fruit clings to the stems very tenaciously, so that unless torn off by birds or other animals it would persist all winter. Now, it has been noticed that about Washington, even in open winters, when bird food of most kinds is reasonably abundant, the berries of poison sumach (*Rhus venenata*) disappear almost entirely before midwinter, and those of the poison ivy (*Rhus toxicodendron*) become scarce soon afterward; while the more conspicuous berries of the harmless sumachs usually remain untouched until later in the season, and in many cases are never eaten at all. These facts would seem to indicate a nice power of discrimination on the part of birds, but I am not able to account satisfactorily for all the facts in this and similar cases.

I would also call attention to our lamentable ignorance as to the species of birds which have the habit already alluded to, of ejecting by the mouth seeds and other indigestible substances taken with food. What birds possess and exercise this power and what birds do not? Bluebirds swallow entire the large fruits of the sour-gum (*Nyssa*) and flowering dogwood (*Cornus florida*); do they eject the seeds, or is it possible that they pass entirely through the alimentary canal? Vireos feed on the large fruits of the sassafras and the even larger ones of some magnolias. In such cases what becomes of the seeds? These and scores of similar questions might be easily answered by any intelligent farmer or collector who would take the trouble to dissect a few specimens at the proper season, or to watch carefully caged specimens fed experimentally. Doubtless many already know just the points that others are wishing to know. Let me beg, then, that others may be given the benefit of your knowledge, and espe-

cially let me ask that so far as possible no collector will throw away the skinned carcass of a bird without at least a glance at the contents of the stomach and a brief note on the label of the skin. And if at times anyone, sportsman, collector, or farmer, finds it convenient to preserve and forward to the Department of Agriculture the stomachs of the specimens killed (no matter how common or well known they may be), the additional trouble taken will be acknowledged and fully appreciated by the Division of Ornithology, and may aid in the solution of economic questions of very great importance.

BIRDS WHICH FEED ON MULBERRIES.

By Dr. C. Hart Merriam.

Groves of mulberry trees during the period of fruiting are thronged by hundreds if not thousands of birds, comprising many species and representing diverse groups. Such insectivorous kinds as flycatchers, warblers, vireos, and even cuckoos, form a part of the heterogeneous assemblage, departing from their customary diet long enough to join the multitude of blackbirds, orioles, finches, sparrows, tanagers, waxwings, catbirds, bluebirds, and thrushes, which from daylight until dark gorge themselves upon the tender berries. It seems incredible that such small birds as warblers, vireos, and the least flycatcher can open their tiny mouths wide enough to swallow such large berries as they really do gulp down with little effort.

I know of no better tree than the mulberry to plant in public and private grounds for the purpose of attracting our resident birds; but unfortunately it does not thrive well north of the limits of the so-called Carolinian Life Zone. The black and the white mulberry (*Morus nigra* and *M. alba*) are the species here referred to.

The following list is incomplete, including such species only as have been actually observed, by Dr. A. K. Fisher and myself, in the act of feeding upon mulberries at Sing Sing, Westchester county, New York, and in the grounds of the Department of Agriculture, Washington, D. C. Several additional species seen in the trees with the others, but not noticed in the act of swallowing berries, are excluded.

Partial list of birds which feed on mulberries.

Yellow-billed Cuckoo (*Coccyzus americanus*).
Downy Woodpecker (*Dryobates pubescens*).
Kingbird (*Tyrannus tyrannus*).
Phœbe (*Sayornis phœbe*).
Wood Pewee (*Contopus virens*).
Least Flycatcher (*Empidonax minimus*).
Cowbird (*Molothrus ater*).
Orchard Oriole (*Icterus spurius*).
Baltimore Oriole (*Icterus galbula*).
Purple Grackle (*Quiscalus quiscula*).
Purple Finch (*Carpodacus purpureus*).
Goldfinch or Thistlebird (*Spinus tristis*).
Chipping Sparrow (*Spizella socialis*).
Song Sparrow (*Melospiza fasciata*).
English Sparrow (*Passer domesticus*).
Scarlet Tanager (*Piranga erythromelas*).
Cedar Waxwing (*Ampelis cedrorum*).
Red-eyed Vireo (*Vireo olivaceus*).
Warbling Vireo (*Vireo gilvus*).
Cape May Warbler (*Dendroica tigrina*).
Yellow Warbler (*Dendroica æstiva*).
Bay-breasted Warbler (*Dendroica castanea*).
Catbird (*Galeoscoptes carolinensis*).
Wood Thrush (*Turdus mustelinus*).
Robin (*Merula migratoria*).
Bluebird (*Sialia sialis*).

REPORT OF THE STATISTICIAN.

SIR: I have the honor to submit my twenty-second annual report as Statistician of the Department of Agriculture.

The office is better equipped for efficient service than in any former year. The clerical force is ample, and its *morale* high. There has always been a difficulty in obtaining efficient expert service for special investigation and for coördination of foreign statistics, from inability to pay what such service commands in unofficial station. In this respect there has been some amelioration, and further improvement is expected. But this branch of the service is ever handicapped by the existing clerical classification, which tends to reduce the civil list to a dead level of mediocrity.

Official exchanges are more extensive than ever before. Statistical documents are received directly from the principal governments of Europe, Asia, Australasia, South America, and from Canada and Mexico. Their diversity in language, denominations of money, and in weights and measures, as well as in methods and subjects of investigation, complicate and increase the labor of compilation and collaboration.

The crop-reporting service is more extended than at any former date, and the constant aim has been to increase its efficiency. It is duplicate in organization, one set of correspondents reporting directly to this office, the other to State agents, who consolidate their returns and report State averages for comparison with those produced by the tabulation of the regular returns. There are 2,338 counties, each represented by a chief correspondent, aided by at least three assistants, from which reports are regularly made to the Department. The corps of the State agents is also very large. Effort is made to obtain men of largest experience and best judgment for this service—men of ability and character, of promptness and reliability, of public spirit and *esprit de corps* as farmers. Some have been twenty years in the work. They have undoubtedly done more extensive and valuable service than any corps of voluntary correspondents in any line of organized effort in the history of the country—content with the compensation afforded by a consciousness of advancing the local and general interests of agriculture and promoting the public good. In both lists there are about thirteen thousand who regularly contribute to the preparation of the county estimates.

These correspondents are engaged in a grand work of primary statistical education. The masses of the people in this country are perhaps freer from ancient prejudices against the "numbering of the people," the census of crop production, and the publicity of information concerning current crop prospects than those of any other. Conscious of existence under free government and liberal institutions, they cower under no tyranny and fear no oppression. They seek only equitable compensation for their labor in production. To ob-

tain this a knowledge of the amount and quality of products, not only of this country but of other countries competing in the same markets, is absolutely necessary; and this can not be obtained in any other way so fully as by the Government in coöperation with other governments. Were it possible, as it is not, for American farmers to obtain this information without Government aid, and keep it a secret of their own, they would be at the mercy of speculators more than ever, as the great advantage and benefaction of national crop reports consists in their regulation of the wild movements of speculative trade, which does not hesitate to exaggerate conditions, misrepresent facts, invent misstatements, and circulate all this misinformation in newspapers of the largest circulation. This causes constant fluctuation in the market, not only facilitating speculating movements, but giving opportunity for largest actual buying of farmers when prices are most depressed. The tenor of best commercial opinion sustains the authoritative character of the national crop report.

The demand for agricultural statistics as a basis for legislation and for intelligent action in business, has never been more eager and general than in the past year. Representatives and citizens of foreign governments have been supplied with data in response to requests for information. Associations, industrial and commercial as well as agricultural, have sought statistics of production and distribution, and editors and authors are constantly requiring and receiving systematic collations of facts required in supplementing their own investigations.

The warmest expression of popular appreciation of the work of this office during the past year has been in commendation of the agricultural graphics extensively distributed to associations, commercial exchanges, schools, and libraries, especially the "Album of Agricultural Statistics." The edition is now practically exhausted, but a series under the name of "Album of Agricultural Graphics" is nearly ready for distribution, presenting the value per acre of each of the ten principal crops which are annually estimated. No small part of its utility comes from the fact that it gives, not the value for a single year, but the average of ten years, thus immensely increasing its value as a fair comparison of the averages of the different States. Another series, now ready for distribution, is a set of six large chromolithographic maps for the use of schools and agricultural institutes, showing the yield of wheat per acre, the distribution of oats and corn, the values of cows and other cattle, and the distribution of rural population.

Investigations are in progress to show the development of the agricultural resources of the Rocky Mountain States and Territories, and bulletins presenting such statistical surveys will be issued from time to time as rapidly as practicable.

Special investigation of the statistics and technology of the vegetable fibers, and those promising future development as sources of new industries, is in progress under an expert, and one report has been issued during the year. Others are in progress.

The office force at present consists of sixty persons, to whom acknowledgment is made of efficient service and willing coöperation in the work of the year.

J. R. DODGE,
Statistician.

Hon. J. M. RUSK,
Secretary.

CROPS OF THE YEAR.

A careful study of the meteorological records of the growing season during 1890 shows that the year was an abnormal one, both in distribution of temperature and rainfall over large sections of the most prominent agricultural States of the Union. With our wide expanse of territory there is almost every year in some portion an unfavorable season, resulting either from drought or an excess of moisture, or from both, at different periods during the season, but the present year is especially remarkable for its abnormal distribution of moisture. In the Atlantic States and in portions of the cotton belt there was a large excess over the normal rainfall; so much that considerable damage to cotton, potatoes, and some other crops resulted. This was more than balanced by the very heavy deficiency which prevailed in the Upper Mississippi and Missouri Valleys and on the Pacific coast, where the rainfall was so scant that over large areas the results of the season were disheartening in the extreme. In the Missouri Valley, including a large portion of the fertile soils of Nebraska, Kansas, and Northern Missouri, the deficiency in rainfall was accompanied during a portion of the year by exceedingly high temperature, making it a period of drought hardly equaled by any in the record of that agricultural region. During the growing season vast areas of yellow and shriveled corn and fields absolutely abandoned testified to the extremity of the disaster, and the final results of the harvest after husking was quite in keeping with the gloomy prospect.

A comparison of the Signal Service records shows that the effects of the drought of the present year were intensified by the fact that last season in the same districts there was a marked deficiency in the moisture supply, rendering the ground still more parched under the blazing sun and cloudless skies of the present year. In the following presentation from official records the aggregate rainfall during the growing season from April to September, for 1889 and 1890, as compared with the normal determined by the records of a series of years, is shown:

Districts.	Rainfall.			Departure of 1890 from the normal.	Departure of 1889 from the normal.
	For a series of years.	For 1890.	For 1889.		
	Inches.	*Inches.*	*Inches.*	*Inches.*	*Inches.*
New England	21.49	22.44	26.47	+0.95	+ 3.23
Middle Atlantic	23.39	25.75	34.09	+2.36	+10.39
South Atlantic	31.53	32.22	31.68	+0.69	— 0.44
Eastern Gulf	30.37	29.21	28.63	—1.16	— 1.74
Western Gulf	23.83	26.85	22.80	+3.02	— 0.20
Ohio Valley and Tennessee	23.22	25.37	22.59	+2.15	— 0.62
Lower Lake region	19.82	22.55	16.48	+2.73	— 1.72
Upper Lake region	20.24	17.37	18.60	—2.87	— 1.51
Extreme Northwest	14.35	13.96	9.63	—0.39	— 4.73
Upper Mississippi Valley	23.05	18.88	19.91	—4.17	— 3.03
Missouri Valley	21.18	15.33	18.35	—5.85	— 3.15
North Pacific coast	14.77	10.07	14.22	—4.70	— 0.91

An analysis of this table shows that the season in New England was practically normal so far as water supply is concerned, though there was a considerable excess during September which seriously interfered with the harvest, especially of root crops, and extended to the Middle Atlantic States, where the remarkably wet year of 1889 was followed during 1890 by one in which there was a considerable excess of moisture, amounting to almost 2½ inches. During the

six months under consideration, in the South Atlantic and Eastern Gulf States the season varied slightly from the normal, and in the Western Gulf region there was an excess of precipitation over the normal of more than 12½ per cent. This excess was received mainly during May, June, and September, and the reports of our correspondents during the season indicated for these months some damage to crop prospects.

The Ohio Valley received almost 10 per cent more rainfall during the summer than its normal amount, and the fact that the excess came almost entirely during August and September increased the damage sustained. The Upper Mississippi Valley, including the Dakotas, Minnesota, and Iowa, suffered from a deficiency of precipitation amounting to more than 4 inches, or almost 20 per cent of the normal rainfall of that period. During 1889 the supply in the same territory was deficient by more than 3 inches. The Missouri Valley, already referred to, failed by almost 6 inches to receive its normal supply, and the deficiency amounted to almost 30 per cent. On the Pacific coast the winter of 1889–'90 was remarkably severe, and the amount of moisture received in the form of rain and snow unusually large. This resulted in disastrous floods and overflows during the early spring, but was followed by a diminished water supply during the summer months, amounting in the more northern districts to nearly 5 inches, or one third of the normal supply.

In order that a more extended comparison of the season may be made, a table showing the rainfall by districts and by months during the growing season of 1890, as compared with the average for a number of years, is appended. During any season a comparison in this detail by months is necessary, as while the total amount of rain received during six months might vary but little from the normal, the variance by months might be great enough to materially injure the harvest of the year. Gentle rainfall, evenly distributed throughout the season, with the proper intervals of sunshine, will bless agriculture with bountiful harvests, while the same amount coming in the form of sudden storms and washing floods will destroy the results of a season's work.

Average rainfall by districts.

Districts.	April.		May.		June.		July.		August.		September.	
	For several years.	1890.	For several years.	1890.	For several years.	1890.	For several years.	1890.	For several years.	1890.	For several years.	1890.
	In.	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*
New England	3.58	3.23	3.54	4.67	3.18	3.25	3.96	3.05	4.22	3.54	3.01	4.70
Middle Atlantic States	3.28	2.88	3.25	4.31	3.96	2.62	4.46	4.33	4.76	5.90	3.68	5.71
South Atlantic States	3.95	2.34	3.87	5.22	5.24	2.33	6.20	8.46	6.72	5.21	5.55	8.66
Eastern Gulf States	5.35	2.75	4.44	6.34	5.53	4.23	5.24	6.97	5.44	4.40	4.37	4.52
Western Gulf States	4.33	6.08	4.87	4.68	3.73	4.86	3.25	1.85	3.20	3.78	4.45	5.60
Rio Grande Valley	1.01	3.39	3.42	2.84	2.64	2.20	1.81	2.63	3.86	1.02	6.22	0.95
Ohio Valley and Tennessee	4.24	4.10	3.92	4.24	4.33	4.17	4.18	2.18	3.63	5.07	2.92	5.61
Lower Lake region	2.33	2.99	3.13	5.32	3.72	3.58	3.50	1.77	3.13	3.48	4.01	5.41
Upper Lake region	2.36	2.57	3.39	4.01	4.04	3.52	3.34	2.50	3.35	3.10	3.76	1.67
Extreme Northwest	1.71	0.82	2.18	1.07	3.43	6.15	3.18	2.13	2.46	1.74	1.39	2.05
Upper Mississippi Valley	3.05	2.30	4.15	4.25	4.98	5.08	3.77	1.46	3.28	3.01	3.32	2.78
Missouri Valley	2.69	1.68	4.72	2.98	4.39	4.32	3.88	2.61	3.07	2.07	2.43	1.67
Northern slope	1.35	1.73	2.81	1.27	3.06	2.34	1.86	1.05	1.61	1.48	1.18	0.85
Middle slope	2.36	3.01	4.01	1.81	2.69	1.61	2.90	0.75	2.71	3.31	2.00	0.61
Southern slope	2.12	6.38	2.64	2.38	3.21	0.64	2.67	2.01	3.09	2.52	3.34	3.36
Southern plateau	0.41	0.78	0.41	0.02	0.49	0.11	2.12	2.24	2.55	3.25	1.28	1.44
Middle plateau	1.74	0.99	1.05	0.54	0.64	0.14	0.56	0.25	0.94	0.80	0.76	0.38
Northern plateau	1.57	0.41	0.99	1.53	1.67	1.32	.....	.....	0.42	0.26	.....	.....
North Pacific coast region	3.72	2.94	2.92	1.34	2.21	2.99	1.30	1.47	0.60	0.94	4.02	0.39
Middle Pacific coast region	2.65	1.40	0.71	1.85	0.36	0.07	0.01	0.01	0.01	.....	0.83	0.89
South Pacific coast region	1.48	0.14	0.40	0.06	0.11	0.01	0.02	.....	0.10	0.03	0.04	0.36

Almost as important in agricultural meteorology as proper rainfall well distributed is the range of temperature. The past season was almost as variable in heat distribution as in water supply. The season opened with April averaging from 1° to 4½° above the normal in the principal agricultural districts east of the Rocky Mountain region. West of that range the cold weather of the abnormal winter still continued. During May conditions were almost exactly reversed, and except east of the Alleghany chain and west of the Rocky range the month was from 1° to almost 5° below the average. This was accompanied in the main by an excess of rainfall, making it a cold wet month not favorable to the inception of farm work. In June, however, temperature ranged high, followed by a July which, as a rule, varied but little from the established records of a long series of years. During August and September the weather was generally cool in all districts, though the range from the normal was not so great as that noted earlier in the season. A record of the average temperature by districts is appended:

Average temperature by districts.

Districts.	April.		May.		June.		July.		August.		September.	
	For several years.	1890.	For several years.	1890.	For several years.	1890.	For several years.	1890.	For several years.	1890.	For several years.	1890.
	°	°	°	°	°	°	°	°	°	°	°	°
New England	43.8	44.5	59.7	58.9	68.4	69.2	68.7	67.9	67.5	67.4	61.9	62.1
Middle Atlantic States	51.5	53.0	63.2	62.8	71.5	73.4	76.3	74.5	74.2	73.3	68.8	68.1
South Atlantic States	62.0	63.0	70.6	71.5	77.7	80.8	80.6	78.7	79.3	78.0	74.7	75.3
Eastern Gulf States	66.8	67.1	73.3	72.1	79.5	80.0	81.7	80.3	80.5	79.1	76.5	75.6
Western Gulf States	64.9	65.9	73.3	72.2	80.2	78.8	83.0	82.6	82.0	80.6	76.5	73.7
Rio Grande Valley	76.0	75.4	80.0	79.7	84.0	82.3	85.4	85.0	84.4	84.8	81.0	81.0
Ohio Valley and Tennessee	56.4	57.4	66.4	64.6	73.9	77.6	77.6	77.4	75.6	73.4	69.7	67.5
Lower Lake region	44.2	45.8	57.5	54.1	66.2	69.4	71.1	71.1	69.1	67.1	63.8	60.8
Upper Lake region	40.2	41.7	52.1	47.5	61.4	65.2	67.9	68.1	65.3	63.2	59.2	57.2
Extreme Northwest	41.0	45.3	54.8	50.0	65.4	67.6	69.2	70.9	66.6	65.0	56.6	55.3
Upper Mississippi Valley	51.8	53.3	62.8	58.7	71.1	74.8	76.7	76.3	73.2	70.2	65.6	61.8
Missouri Valley	50.3	53.2	61.0	58.3	70.8	72.9	75.3	77.3	72.7	70.7	64.2	62.3
Northern slope	44.1	45.4	53.2	53.4	63.0	62.0	69.8	72.6	68.0	67.2	58.4	58.2
Middle slope	54.2	54.2	62.8	63.4	73.0	73.5	76.3	79.2	74.0	73.9	66.7	64.7
Southern slope	63.4	61.4	70.6	70.4								
Southern plateau	57.9	59.5	66.7	68.7	74.9	73.6	80.7	81.2	78.0	75.8	71.2	72.3
Middle plateau	48.4	49.4	56.5	59.7	65.5	62.5	74.0	74.7	72.4	70.8	62.6	62.6
Northern plateau	49.4	50.2	58.0	59.2	64.6	61.6						
North Pacific coast region	49.5	47.5	57.0	58.9	58.0	56.4	63.8	62.6	63.2	63.4	58.2	57.1
Middle Pacific coast region	58.3	58.0	63.0	64.3	67.3	66.5	71.6	71.3	71.0	71.3	68.7	68.4
South Pacific coast region	59.5	59.0	63.0	61.8	66.4	65.8	70.0	70.8	71.0	71.3	70.6	70.2

For convenience of examination, the departure from the normal, both in temperature and rainfall, for the districts comprising the principal agricultural sections of the country for each month during the growing season, is appended:

Districts.	April.		May.		June.		July.		August.		September.	
	Temperature.	Rainfall.	Temperature.	Rainfall.	Temperature.	Rainfall.	Temperature.	Rainfall.	Temperature.	Rainfall.	Temperature.	Rainfall.
	°	In.	°	In.	°	In.	°	In.	°	In.	°	In.
New England	−0.7	−0.95	+0.2	+1.13	−1.2	+0.07	−0.8	−0.91	−0.1	−0.68	+0.2	+1.69
Middle Atlantic	−1.5	+0.40	−0.4	−1.06	+1.9	−1.34	−1.8	−0.13	−0.9	+1.14	−0.7	+2.03
South Atlantic	+1.0	−1.67	+0.9	−1.85	+2.1	−2.91	−1.9	+2.26	−1.3	−1.51	+0.6	+3.11
Eastern Gulf	+0.8	+2.60	−1.2	−1.90	+0.5	+1.30	−0.9	+1.73	−1.4	−1.04	−0.9	+0.15
Western Gulf	+1.0	+1.75	−1.0	−0.19	−1.4	+1.13	−0.4	−1.40	−1.4	+0.58	−2.8	+1.15
Ohio Valley and Tennessee	+1.0	−0.14	−1.8	+0.35	+3.7	−0.16	−0.2	−2.00	−2.2	+1.44	−2.2	+2.69
Lower Lake region	+1.6	+0.66	−3.4	+2.19	+3.2	−0.14	0.0	−1.73	−2.0	+0.35	−3.0	+1.40
Upper Lake region	+1.5	+0.21	−4.6	+0.62	+3.8	−0.52	+0.9	−0.84	−2.1	−0.25	−2.0	−2.09
Extreme Northwest	+4.3	−0.89	−4.8	+1.11	−2.2	+2.72	+1.7	−1.05	−1.6	−0.72	−1.3	+0.66
Upper Mississippi Valley	+1.5	−0.75	−4.1	+0.10	+3.7	+0.10	−0.4	−2.31	−3.0	−0.27	−3.8	−1.04
Missouri Valley	+2.9	−1.01	−2.7	−1.74	+2.1	−0.07	+2.0	−1.27	−2.0	−1.00	−1.9	−0.76
North Pacific coast	−2.0	−0.78	+1.9	−1.58	−1.6	+0.78	−1.2	+0.17	+0.2	+0.34	−1.7	−3.63
Middle Pacific coast	−0.3	−1.25	+1.3	+1.14	−0.8	−0.29	−0.3	.....	+0.3	−0.01	−0.3	+0.56

These records indicate an abnormal season and point to depreciated yields of crops most affected by such meteorological influences. A winter so mild that cotton in some situations was growing and flowering in midwinter, and seeds and grains sprouted and grew as volunteer crops, was not calculated to produce hardy growths that could withstand the inevitable fluctuations of March weather. In the Central and most of the Northern States the winter was unusually mild, grain was unprotected by snows and too succulent to endure the winds and frosts, which are sure to come before spring. The result was a worse injury of winter grain, over a wider area, than occurs in the average of bad seasons, and a frosting of citrus fruits on the Gulf coast and peninsula of Florida, which cut off a part of the season's crops and delayed the development of orange groves.

Winter wheat was injured seriously, and large areas in certain States were planted in other crops. Well-rooted plants, that in good soils or in tile-drained and drilled fields escaped the disruption so disastrous in "sprouting" soils, made good yields. A greater disparity in rate of yield has rarely been seen. From a heavy crop to a nearly absolute failure the range has been extreme.

Spring wheat started fairly well and improved slightly during June. In Minnesota a rank growth was reported and fears of blight from high temperature were entertained; chinch bugs began to threaten certain districts, and indications of rust appeared. In Dakota a deficiency of moisture was already apparent. During July there was a reduction in condition of eleven points. High temperature and hot winds wrought some damage to the ripening grain.

The changes in condition of winter and spring wheat from month to month as compared with those of 1889 are thus presented:

Year.	April.	May.	June.		July.		August.	When harvested.	
	W.	W.	W.	S.	W.	S.	S.	W.	S.
1889	94	96	93.1	94.4	92.0	83.3	81.2	89.4	83.8
1890	81	80	78.1	91.3	76.2	94.4	83.2	73.5	79.8

The corn crop started well with an average in July, the date of first report of condition, of 93.1, a figure higher than any in 1888 and 1889, and but little, if any, below an average July condition during the past decade. During July and August the drought, which was especially severe in the section growing the great bulk of commercial corn, set in, and in sixty days condition was reduced to 70.1 per cent. This rapid falling off in condition is only equaled by the decline which took place during the same period in 1887 from similar causes.

The weather during October was favorable for ripening and harvesting, frost holding off until the great bulk of the crop was hard and of merchantable quality, except as injured by the drought. It ripened well in northern New England, though in New York and Pennsylvania late maturation caused a considerable amount of soft corn. The excess of moisture during the latter part of the season along the Atlantic coast was rather unfavorable to ripening and delayed gathering and husking. The aggregate product is very much reduced, making only about 70 per cent of the great crop of 1889; the loss resulting from the smaller area harvested and the very heavy reduction in the rate of yield.

The returns of the oats crop were unfavorable from the beginning, condition at the June report, the first of the season, standing at only 89.8, or the lowest figure, with one exception, ever recorded in the crop-reporting history of the Department. This poor condition was due to unfavorable meteorological influences prevailing at time of sowing in many districts, and to drowning out of the crop in low and bottomlands by spring floods. During the month of June there was a decline in condition of 8 points, most severe along the Atlantic coast and in the Ohio Valley, and condition on the first of July was only 81.6. Over a large portion of the district of heavy production the plant was weak, enfeebled by alternations of temperature, and readily susceptible to damage from attacks of insects or blight. During July attacks of blight were reported in almost every section of the country except the Northwest, and condition fell away rapidly to 70.1 at the August report; the lowest figure ever reported for this crop in any month up to that date. At time of harvest, however, the injury sustained was still more apparent, and the result is a yield of only 19.8 bushels per acre, the lowest rate ever reported for this crop.

Of the minor cereals, rye and barley make yields considerably smaller than the average for a series of years, resulting from the same unfavorable conditions which shortened the product of the principal cereals. Buckwheat, however, coming later in the growing season, made a crop larger than usual, the yield being estimated at 14½ bushels upon an area somewhat in excess of that of 1889. With the exception of last year, this is the largest yield per acre reported during the past decade.

The potato crop suffered from unfavorable weather at time of planting and at time of harvest. This was especially true in New England and the Ohio Valley; condition throughout the season was low, and the returns of yield per acre were in close harmony with the season's record. The estimated yield per acre is only 57½ bushels, which, with two exceptions, is the lowest yield ever reported. The same conditions which injured the crop during the early growing season resulted in making the area smaller than was originally intended. The actual supply for consumption per head of population

of this important food crop is smaller than in any recent year. It should not be hastily assumed, however, that the apparent decline in the yield per acre of this crop during the past ten years is permanent, or that it results from any deterioration in fertility of soil or quality of seed. The last ten years have contained an unusually large number of seasons of unfavorable meteorological conditions—seasons of drought or of rainfall, or an injurious combination of both—which are hardly likely to reappear again with such frequency. With favorable weather, careful attention to selection of seed, and scientific rotation in cropping, a yield as large as any made in previous years may be confidently expected; in fact, during the past decade there were two favorable seasons when the outcome exceeded 90 bushels per acre.

The sugar crop has been a large one; the product of cane sugar in Louisiana being much in excess of that of last year, and undoubtedly the largest in thirty years. The year marks an important forward step in our experiments with other sugar-producing plants—the making of sugar from beets having been a commercial success in Nebraska, Kansas, and California. The results of this campaign give promise that the time when this country shall be less dependent for this staple article upon the plantations of foreign countries is at hand, and it may be that within a few years the $90,000,000 annually sent abroad will go to the pockets of our own farmers.

The hay crop of 1890 is above the average, both in breadth and in yield per acre. The extension of cultivated grasses in the South, and on the Great Western Plains, where formerly stock raising was carried on with no provision for winter feeding beyond that provided by nature in the dried buffalo and other wild grasses, which has been a marked feature of American agriculture during recent years, has continued. The search for grasses and forage plants which can withstand the high temperature and scanty moisture of the semi-arid districts of the Rocky Mountain regions continues. Alfalfa in many locations, especially where the scanty precipitation can be eked out with even a minimum distribution of water by irrigation, is regarded by many as a solution of the problem, and the increase in the product of this nutritious hay has been very rapid during recent years in Colorado, Wyoming, Utah, and other sections of the mountain region.

The estimated average yield per acre for the total area of all grasses cut for hay is 1.2 tons, a figure somewhat above the average for the past ten years. Except in the drought-stricken districts, the season was in the main favorable for maximum production, the excess of moisture characterizing the early spring months giving a strong, luxuriant growth which carried the crop through the less favorable period of its later growth.

The apple, peach, and small fruit crops were very deficient in almost every section of the country, except the Pacific coast, where there was a medium supply. The failure was the result of the mild, open winter which prevailed throughout the country east of the Rocky Mountains, the growth of new wood and of fruit buds continuing during the usual period of rest, making the variable weather of March unusually trying. California fruits and grapes have occupied a commanding position in the markets of the great cities, and the season was one of great prosperity to the horticultural interests of that State. The supply of oranges and other tropical fruits and delicacies from the Pacific coast and from Florida has been fairly

abundant, and each year demonstrates our ability to compete with foreign planters in new lines of production. Our possibilities for fruit production are becoming recognized, and the range is almost limitless.

The cotton crop of 1889 was the largest ever grown up to that date, but the indications of condition throughout the growing season with the annual enlargement of area, point to a somewhat larger product for 1890. We grow now three fourths of the cotton consumed in the manufactures of the civilized world, and as the demands for the fiber have quite kept pace with the increased product which our planters have marketed year after year, there has been no glut or overproduction, and prices have been maintained at a steady and remunerative level.

The increased interest in sheep husbandry, noted a year ago, has been continued, and this has been probably the most profitable branch of our stock industry during the year. The decline in wool production which began with the slaughter of flocks in 1884–'85, has been checked, the aggregate clip for 1890 (fall of 1889 and spring of 1890) being estimated at 276,000,000 pounds, an increase of 11,000,000 pounds over the previous season.

CEREAL CROPS OF THE YEAR IN DETAIL.

As noted in the general review, the season was distinctly unfavorable to full production of any of the staple cereals. Seeding and planting took place under discouraging circumstances; the period of early growth was attended by adverse meteorological conditions, the later season marked by alternations of flood and drought, and even the harvest interfered with by the lack of seasonable weather. All of these unfavorable conditions were, of course, not constantly present everywhere, but they were present throughout the whole crop year in one district or another of large production, and there is hardly a prominent grain State in which the yield per acre of corn, oats, or winter wheat is as large as the average of the past ten years.

It must not be presumed, however, that this partial crop failure will result in a stinted domestic food supply, or even prevent America from still being the granary from which the Old World may draw supplies with which to eke out her own deficiencies. With a crop of corn 30 per cent smaller than that of the previous year, making the smallest yield per acre with two exceptions noted in twenty years, we have a production per head of our population of 23 bushels, or 50 per cent more than the average production per capita of all cereals in Europe. Of wheat we have grown this year nearly twice the average per head of Europe, and our reserves, though somewhat depleted, with the small surplus which will remain over home requirements from this crop, will enable us to meet all probable foreign demands should ruling prices warrant a close clearing up of both visible and invisible stocks.

CORN.

The area of corn, which was slightly increased in planting, was reduced by failure and utter abandonment by more than 6,000,000 acres, the breadth harvested being estimated at 71,970,763 acres. In this breadth there is properly included all areas not absolutely abandoned, all fields, even though producing but a few bushels per acre,

and this fact, as well as that the estimated production is not in merchantable corn, but all corn—good, bad, soft, or nubbins—should be borne in mind in all comparisons with previous years, and in calculations of commercial supplies. The question of proportion of the crop merchantable is always investigated later, after husking and partial feeding of the crop give ample opportunity for mature judgment. The greater portion of the 6,000,000 acres planted but abandoned was of course in Kansas and Nebraska, the result of the severe drought which afflicted large areas in each State, but there was an unusually large area so lost in many other districts.

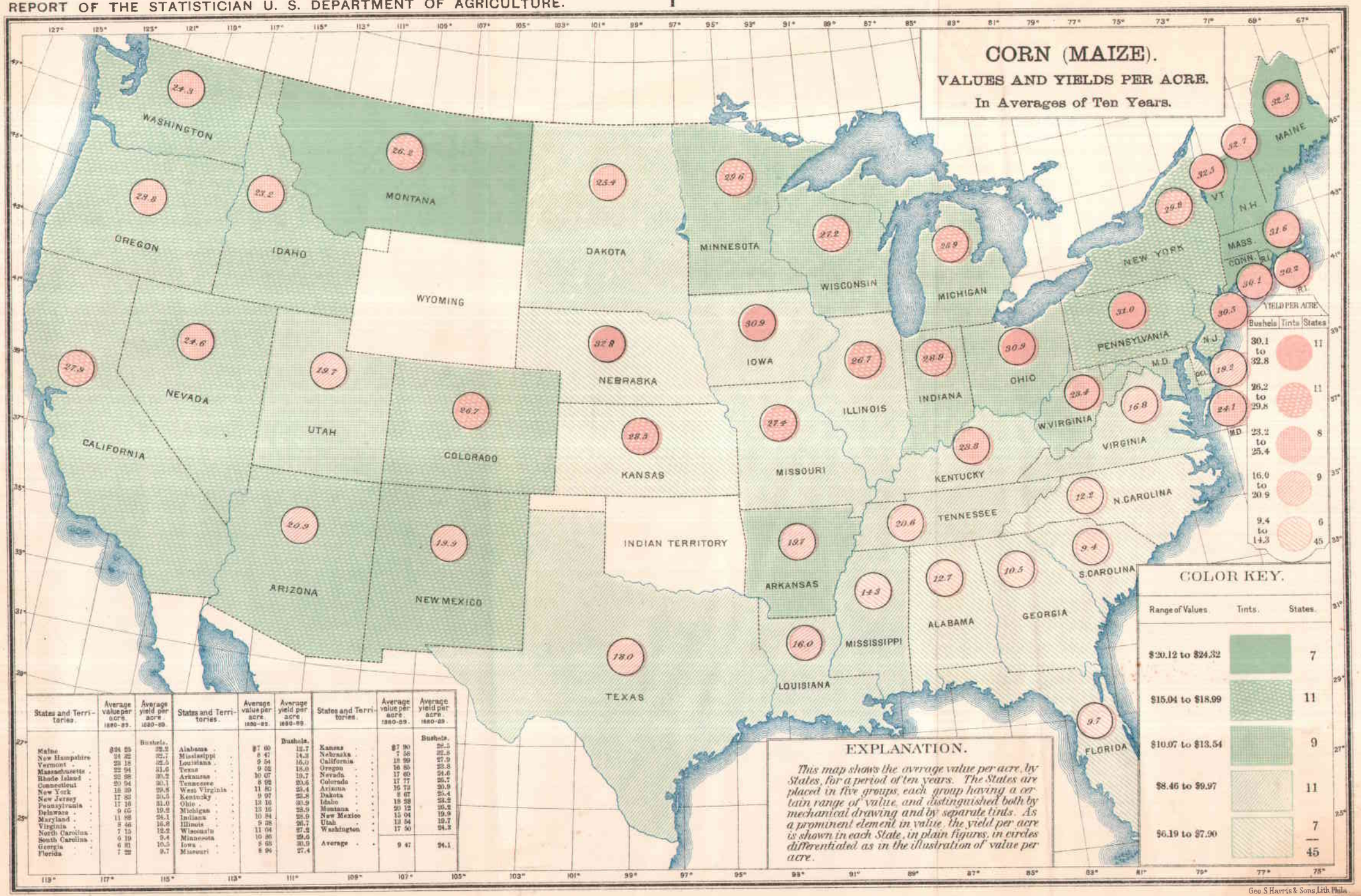
The estimated product is 1,489,970,000 bushels, or a yield of 20.7 bushels per acre. With the single exception of 1887, another year of severe drought, this is the smallest aggregate grown in any year since 1881. It is only 70 per cent of last year's great crop, but the disparity in commercial corn between the two seasons is even greater. The seven States of Ohio, Indiana, Illinois, Iowa, Missouri, Kansas, and Nebraska are the corn-surplus States, practically furnishing all that enters commercial channels. The crop in the other States is consumed where grown, and it exerts an influence on commercial corn only as it supplies home requirements or makes necessary a demand on the surplus States. Outside of these seven States the yield is practically only of local interest.

The returns of farm value of the crop show in a striking way the influence of short crops upon prices. While the crop aggregates only 70 per cent of that of last year, the aggregate money value of the crop to the producer is $156,000,000 greater.

The advance in value is in greater ratio than the decline in volume. It proves that the law of supply and demand still controls, and that small crops are a sure cure for low prices, but unfortunately the absolute failure of the crop in large districts prevents all growers from sharing in the average enhancement of the remaining product.

The estimated acreage, product, and value of the crop, by States, is thus presented:

States and Territories.	Acres.	Bushels.	Value.
Maine	27,355	1,008,000	$746,180
New Hampshire	34,487	1,259,000	906,319
Vermont	54,893	1,839,000	1,324,020
Massachusetts	54,134	1,868,000	1,307,336
Rhode Island	12,307	402,000	289,756
Connecticut	56,407	2,014,000	1,409,611
New York	642,896	17,101,000	11,115,672
New Jersey	357,342	11,185,000	6,934,579
Pennsylvania	1,383,377	38,043,060	22,825,721
Delaware	223,136	4,128,000	2,064,008
Maryland	725,907	16,333,000	8,166,454
Virginia	2,109,853	36,923,000	20,307,335
North Carolina	2,726,586	36,264,000	19,944,977
South Carolina	1,576,230	16,078,000	11,254,282
Georgia	2,981,486	31,306,000	21,600,866
Florida	491,428	4,570,000	3,427,710
Alabama	2,489,226	25,390,000	17,265,271
Mississippi	1,951,651	24,396,000	17,076,947
Louisiana	1,061,169	16,979,000	11,885,093
Texas	4,116,281	63,802,000	45,937,696
Arkansas	2,002,575	33,443,000	21,737,952
Tennessee	3,600,657	67,692,000	35,200,023
West Virginia	671,733	13,435,000	8,060,796
Kentucky	2,816,155	63,645,000	31,186,100
Ohio	2,827,277	65,876,000	33,596,533
Michigan	977,188	26,580,000	14,618,733
Indiana	3,604,252	89,025,000	41,841,761
Illinois	7,154,424	187,446,000	80,601,741
Wisconsin	1,102,022	33,061,000	14,877,297
Minnesota	768,449	21,286,000	8,940,126



States and Territories.	Average value per acre. 1880-89.	Average yield per acre. 1880-89.
		Bushels.
Maine	$24 25	32.2
New Hampshire	24 32	32.7
Vermont	23 18	32.5
Massachusetts	22 94	31.6
Rhode Island	22 98	30.2
Connecticut	23 94	30.1
New York	18 39	29.8
New Jersey	17 83	30.5
Pennsylvania	17 16	31.0
Delaware	9 65	19.2
Maryland	11 98	24.1
Virginia	8 46	16.8
North Carolina	7 15	12.2
South Carolina	6 19	9.4
Georgia	6 81	10.5
Florida	7 22	9.7

States and Territories.	Average value per acre. 1880-89.	Average yield per acre. 1880-89.
		Bushels.
Alabama	$7 60	12.7
Mississippi	8 47	14.3
Louisiana	9 54	16.0
Texas	9 52	18.0
Arkansas	10 07	19.7
Tennessee	8 92	20.6
West Virginia	11 80	23.4
Kentucky	9 97	23.8
Ohio	13 10	30.9
Michigan	13 15	28.9
Indiana	10 84	28.9
Illinois	9 98	26.7
Wisconsin	11 04	27.2
Minnesota	10 86	29.6
Iowa	8 68	30.9
Missouri	8 96	27.4

States and Territories.	Average value per acre. 1880-89.	Average yield per acre. 1880-89.
		Bushels.
Kansas	$7 90	28.5
Nebraska	7 58	28.8
California	18 99	27.9
Oregon	16 85	23.8
Nevada	17 60	24.6
Colorado	17 77	26.7
Arizona	16 72	20.9
Dakota	8 67	25.4
Idaho	19 88	23.2
Montana	20 12	26.2
New Mexico	15 04	19.9
Utah	12 54	19.7
Washington	17 90	24.3
Average	9 47	24.1

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States and Territories.	Acres.	Bushels.	Value.
Iowa	8,771,299	232,439,000	95,300,164
Missouri	6,796,318	175,345,000	77,151,802
Kansas	3,542,891	55,269,000	28,187,241
Nebraska	3,072,800	55,310,000	26,548,992
California	159,871	4,396,000	2,857,694
Oregon	8,011	173,000	114,205
Colorado	42,133	767,000	483,097
The Dakotas	884,593	12,030,000	6,015,233
New Mexico	56,289	1,126,000	821,819
Utah	35,175	739,000	502,299
Total	71,970,763	1,489,970,000	754,433,451

For purpose of comparison a presentation, in condensed form, of the results for a long series of years is given. An examination of the table shows that with one exception the crop of 1890 is the smallest of the decade and with the same exception the most valuable per unit of quantity. The course of price follows closely the course of product, the highest price going with the smallest crop, in 1881, and the lowest price with the largest crop, in 1889. The decline in average yield between the period 1870–'79 and 1880–'89 can not be attributed to any decline in fertility or be considered as permanent. The first period included an unusually large number of fat years, years of plenty, in which nature smiled upon the efforts of the husbandman, while the latter number many that were lean, when droughts and floods robbed the worker of the fruits of his labor.

The statement is as follows:

Years.	Total production.	Total area of crop.	Total value of crop.	Average value per bushel.	Average yield per acre.	Average value per acre.
	Bushels.	*Acres.*		*Cents.*	*Bushels.*	
1880	1,717,434,543	62,317,842	$679,714,499	39.6	27.6	$10.91
1881	1,194,916,000	64,262,025	759,482,170	63.6	18.6	11.82
1882	1,617,025,100	65,659,545	783,867,175	48.5	24.6	11.94
1883	1,551,066,895	68,301,889	658,051,485	42.4	22.7	9.63
1884	1,795,528,000	69,683,780	640,735,560	35.7	25.8	9.19
1885	1,936,176,000	73,130,150	635,674,630	32.8	26.5	8.69
1886	1,665,441,000	75,694,208	610,311,000	36.6	22.0	8.06
1887	1,456,161,000	72,392,720	646,106,770	44.4	20.1	8.93
1888	1,987,790,000	75,672,763	677,561,580	34.1	26.3	8.95
1889	2,112,892,000	78,319,651	597,918,829	28.3	27.0	7.63
1890	1,489,970,000	71,970,763	754,433,451	50.6	20.7	10.48
Total	18,524,400,538	777,405,336	7,443,857,149			
Average, 11 years, 1880 to 1890	1,684,036,413	70,673,212	676,714,286	40.2	23.8	9.58
Average, 10 years, 1880 to 1889	1,703,443,054	70,543,457	668,942,370	39.3	24.1	9.48
Average, 10 years, 1870 to 1879	1,184,486,954	43,741,331	504,571,048	42.6	27.1	11.54

The great bulk of our corn crop is used at home, in fact is consumed upon the farms where grown, and but a very small proportion is ever shipped abroad. The shipments, however, small as they are, are extremely variable, depending entirely upon the domestic price. When the volume was greatest it amounted to but 6.5 per cent of the crop, and from that it ranges down to 1 per cent. The production and exportation, with the annual average of each for twenty years, is presented in the following statement, showing that during that period the foreign demand has amounted to only 3.9 per cent of our production.

Production and export of corn.

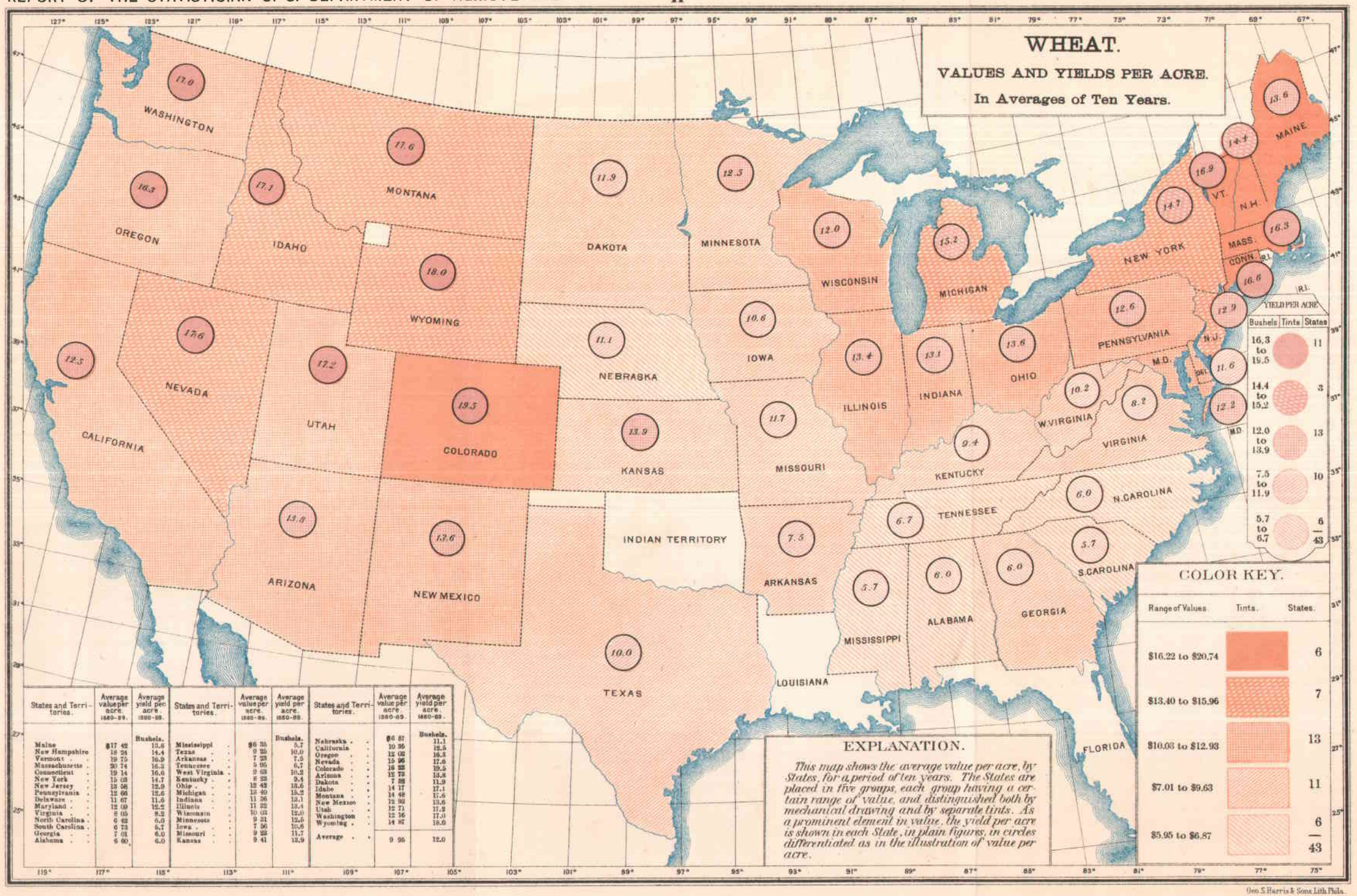
Years.	Production.	Exports.	Exportation.	Years.	Production.	Exports.	Exportation.
	Bushels.	*Bushels.*	*P. ct.*		*Bushels.*	*Bushels.*	*P. ct.*
1870	1,094,255,000	10,673,553	1.0	1881	1,194,916,000	44,340,683	3.7
1871	991,898,000	35,727,010	3.6	1882	1,617,025,100	41,655,653	2.6
1872	1,092,719,000	40,154,374	3.7	1883	1,551,066,895	46,258,606	3.0
1873	932,274,000	35,985,834	3.9	1884	1,795,528,000	52,876,456	2.9
1874	850,148,500	30,025,036	3.5	1885	1,936,176,000	64,829,617	3.3
1875	1,321,069,000	50,910,532	3.9	1886	1,665,441,000	41,368,584	2.5
1876	1,283,827,500	72,652,611	5.7	1887	1,456,161,000	25,360,869	1.7
1877	1,342,558,030	87,192,110	6.5	1888	1,987,790,000	70,841,673	3.6
1878	1,388,218,750	87,884,892	6.3	1889	2,112,892,000	103,418,709	4.9
1879	1,754,591,676	99,572,329	5.7				
1880	1,717,434,543	93,648,147	5.5	Annual average	1,454,200,498	56,768,864	3.9

WHEAT.

The estimate of the wheat crop of 1890 was closely foreshadowed by the various returns of condition throughout the season. The October estimate of yield per acre is confirmed by later investigations, by returns of thrashing, and by the record of individual cultivators received and tabulated during December. The aggregate area harvested is estimated at 36,087,154 acres, against 38,123,859 acres in 1889 and 35,430,333 acres in 1879. This shows but little increase in the breadth harvested during the last ten years, though within that period the acreage ran up to nearly 40,000,000 acres in 1884 and fell away to 34,000,000 in 1885.

The total product is estimated at 399,262,000 measured bushels. The commercial demand that the crop be given in bushels by weight can not be acceded to. While in elevators, on railroads, and in commercial transactions the bushel means 60 pounds without regard to volume, yet farmers are accustomed to use and to think in the measured bushel. To require them to still further complicate their estimates of yield per acre by a mental calculation of quality to ascertain average weight would be unreasonable and the results misleading. The question of quality and weight is an after consideration, and is reported upon by this office in March of each year, when records of inspections are available, when millers and elevator men by actual tests of the scales can give authoritative answers. It is well known that no crop ever averages up to the standard of 60 pounds per bushel, the average for a series of years being probably between 57 and 58 pounds. Past records have shown that the annual variance in weight of the crop is not much more than a pound above or below this average, the extreme range in seven years being from 56.5 in 1888 to 58.5 in 1887.

The season was especially unfavorable in the winter-wheat States, those east of the Rocky Mountains suffering from damage wrought by March freezing when fields were bare of snow protection, and the Pacific coast from floods and overflows in the early spring. In no State in which the winter grain makes the bulk of the product is the rate of yield as high as the State average of the last ten years. The year was more favorable in the spring-wheat districts, the yield in the principal States, except the Dakotas, being quite as large as



States and Territories.	Average value per acre. 1880-89.	Average yield per acre. 1880-89.
		Bushels.
Maine	$17 42	13.6
New Hampshire	19 24	14.4
Vermont	19 75	16.9
Massachusetts	20 74	16.3
Connecticut	19 14	16.6
New York	15 03	14.7
New Jersey	13 56	12.9
Pennsylvania	12 66	12.6
Delaware	11 67	11.6
Maryland	12 59	12.2
Virginia	8 05	8.2
North Carolina	6 42	6.0
South Carolina	6 73	6.7
Georgia	7 01	6.0
Alabama	6 60	6.0

States and Territories.	Average value per acre. 1880-89.	Average yield per acre. 1880-89.
		Bushels.
Mississippi	$6 35	5.7
Texas	9 25	10.0
Arkansas	7 23	7.5
Tennessee	5 95	6.7
West Virginia	9 63	10.2
Kentucky	8 23	9.4
Ohio	12 43	13.6
Michigan	13 40	15.2
Indiana	11 56	13.1
Illinois	11 32	13.4
Wisconsin	10 03	12.0
Minnesota	9 31	12.5
Iowa	7 56	10.6
Missouri	9 32	11.7
Kansas	9 41	13.9

States and Territories.	Average value per acre. 1880-89.	Average yield per acre. 1880-89.
		Bushels.
Nebraska	$6 87	11.1
California	10 35	12.5
Oregon	12 02	16.3
Nevada	15 96	17.6
Colorado	16 22	19.5
Arizona	12 75	13.8
Dakota	7 86	11.9
Idaho	14 17	17.1
Montana	14 48	17.6
New Mexico	12 93	13.6
Utah	12 71	17.2
Washington	12 16	17.0
Wyoming	14 87	18.0
Average	9 95	12.0

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the average. The division into spring and winter wheat is thus made:

	Acres.	Bushels.	Per acre.
Spring	12,567,050	143,888,000	11.4
Winter	23,520,104	255,374,000	10.9

The value of our wheat crop, unlike that of corn, which is regulated by the domestic demand alone, is dependent upon other factors than the volume of our own crop. Its price is affected by the supply of the world, drawn from all sources of production, and as a consequence we have had some large crops with high prices and small crops with lower values. The crop of the United States, however, is a prominent element in determining the world's surplus, and to that extent determines values. The farm value of the present crop has advanced to nearly 84 cents per bushel, and the aggregate value is $334,773,678, only $8,000,000 short of the value of the crop of 1889, although the crop is smaller by more than 90,000,000 bushels.

The estimates in detail, by States, are as follows:

States and Territories.	Acres.	Bushels.	Value.
Maine	40,218	543,000	$624,367
New Hampshire	9,155	140,000	161,083
Vermont	19,478	335,000	371,874
Connecticut	1,876	30,000	33,018
New York	640,540	9,288,000	9,287,830
New Jersey	138,833	1,680,000	1,679,879
Pennsylvania	1,337,437	16,049,000	15,898,752
Delaware	94,790	919,000	882,684
Maryland	535,143	6,308,000	5,711,046
Virginia	801,956	5,614,000	5,289,144
North Carolina	717,228	3,156,000	3,155,803
South Carolina	178,609	750,000	787,666
Georgia	344,159	1,411,000	1,552,157
Alabama	293,049	1,319,000	1,437,406
Mississippi	60,750	286,000	314,978
Texas	510,711	3,575,000	3,396,228
Arkansas	221,848	1,375,000	1,542,619
Tennessee	1,175,032	7,873,000	7,636,663
West Virginia	362,666	2,826,000	2,209,759
Kentucky	943,518	9,152,000	8,419,955
Ohio	2,398,741	29,984,000	27,285,679
Michigan	1,501,561	20,271,000	18,243,967
Indiana	2,493,605	27,928,000	24,576,971
Illinois	1,853,173	18,161,000	15,800,153
Wisconsin	1,073,475	13,996,000	10,870,008
Minnesota	3,143,917	38,356,000	31,068,187
Iowa	1,685,080	19,041,000	15,253,123
Missouri	1,603,459	17,628,000	14,639,581
Kansas	2,058,000	28,195,000	21,709,842
Nebraska	1,418,059	15,315,000	11,639,423
California	2,426,730	29,121,000	22,131,778
Oregon	887,250	12,905,000	9,648,844
Nevada	18,489	250,000	214,658
Colorado	96,030	1,777,000	1,439,010
Arizona	25,930	311,600	280,044
The Dakotas	4,209,482	40,411,000	28,287,719
Idaho	83,056	1,370,000	1,068,931
Montana	87,550	1,468,000	1,190,680
New Mexico	90,610	1,105,000	1,050,170
Utah	180,251	2,279,000	1,777,927
Washington	496,275	8,071,000	6,194,027
Total	26,687,154	399,302,000	334,773,678

An examination of the results of each harvest since 1880 shows that in but two years has the average yield been lower than that of the present crop, in 1881 and in 1885, the only years in which the de-

ficiency in an aggregate volume was greater. At the same time the average value of the crop has been greater in five years of the eleven, showing that price is influenced in a large measure by the crops of other lands. The average yield per acre has been very uniform during each of the ten-year periods since 1870, the difference being less than one-third of a bushel.

Years.	Total production.	Total area of crop.	Total value of crop.	Average value per bushel.	Average yield per acre.	Average value per acre.
	Bushels.	*Acres.*		*Cents.*	*Bushels.*	
1880	498,549,868	37,986,717	$474,201,850	95.1	13.1	$12.48
1881	383,280,090	37,709,020	456,880,427	119.2	10.2	12.12
1882	504,185,470	37,067,194	444,602,125	88.2	13.6	11.99
1883	421,086,160	36,455,593	383,649,272	91.1	11.6	10.52
1884	512,765,000	39,475,885	330,862,260	64.5	13.0	8.38
1885	357,112,000	34,189,246	275,320,390	77.1	10.4	8.05
1886	457,218,000	36,806,184	314,226,020	68.7	12.4	8.54
1887	456,329,000	37,641,783	310,612,960	68.1	12.1	8.25
1888	415,868,000	37,336,138	3 5,248,030	92.6	11.1	10.32
1889	490,560,000	38,123,859	342,491,707	69.8	12.9	8.98
1890	399,262,000	36,087,154	334,773,678	83.8	11.1	9.28
Total	4,896,215,588	408,878,773	4,052,868,719			
Average, 11 years, 1880 to 1890	445,110,508	37,170,798	368,442,611	82.8	12.0	9.91
Average, 10 years, 1880 to 1889	449,695,359	37,279,162	371,809,504	82.7	12.1	9.97
Average, 10 years, 1870 to 1879	312,152,728	25,187,414	327,407,258	104.9	12.4	13.00

OATS.

There is a decrease from the acreage of 1889 of slightly more than a million acres in the area of oats harvested, but the great falling off in the volume of the crop is the result of the deficient yield per acre. The year was especially unfavorable for this crop from the beginning, and the final yield is the logical sequence of the returns of condition throughout the growing season. The steady enlargement in the volume of this crop has been one of the features of our agriculture during the past decade, and, like corn, the demand has been for domestic consumption. Its use for human food is steadily increasing, though the aggregate thus used is small. Like corn it is used as feed for animals, and there is an intimate relation between the two grains growing out of their interchangeable use. The value of the crop depends partially upon the size of the corn crop, and the present crop, short itself, and coming with a small corn yield, commands a high price. The farm price is the highest in ten years, except in 1881, another year of short corn yield.

The yield per acre averages but 19.8 bushels, the lowest ever returned by this office, while the average for a series of years would not be far from 27 bushels.

As in the case of corn, the short crop of the present year is worth more in the aggregate to producers than the crop of 1889, which was the largest ever grown. With a decline in volume of more than 225,000,000 bushels there is an absolute increase in value of $50,000,000. There is a lesson of wisdom in these figures, a remedy for low prices.

The estimates in detail are as follows:

States and Territories.	Acres.	Bushels.	Value.
Maine	100,607	2,847,000	$1,622,891
New Hampshire	31,359	862,000	482,929
Vermont	106,591	2,793,000	1,396,342
Massachusetts	23,275	598,000	328,992
Rhode Island	6,545	153,000	82,703
Connecticut	30,019	780,000	413,601
New York	1,343,418	23,913,000	11,956,420
New Jersey	141,537	2,449,000	1,224,295
Pennsylvania	1,277,424	21,972,600	10,546,413
Delaware	22,931	298,000	134,146
Maryland	113,075	1,357,000	597,036
Virginia	672,178	6,587,000	2,964,305
North Carolina	673,672	6,198,000	3,160,869
South Carolina	393,226	4,168,000	2,500,918
Georgia	562,387	5,455,000	3,273,092
Florida	53,540	573,000	349,456
Alabama	405,344	4,864,000	3,015,759
Mississippi	361,992	4,778,000	2,866,976
Louisiana	42,952	567,000	345,849
Texas	639,274	11,059,000	6,082,692
Arkansas	293,831	3,967,000	2,102,361
Tennessee	682,759	6,486,000	2,918,795
West Virginia	142,107	1,506,000	677,850
Kentucky	465,152	3,954,000	1,779,206
Ohio	1,111,332	20,004,000	8,401,670
Michigan	941,088	25,033,000	11,014,494
Indiana	1,017,422	17,800,000	7,297,850
Illinois	3,372,451	70,821,000	29,036,803
Wisconsin	1,496,888	38,919,000	15,567,635
Minnesota	1,500,084	38,402,000	14,208,796
Iowa	2,767,330	71,397,000	27,130,903
Missouri	1,412,571	24,579,000	9,585,707
Kansas	1,302,884	31,269,000	11,882,302
Nebraska	1,053,059	22,430,000	8,747,761
California	70,655	1,943,000	1,088,087
Oregon	221,940	6,658,000	3,329,100
Colorado	100,725	2,498,000	1,248,990
The Dakotas	1,183,157	24,846,000	7,950,815
Idaho	36,440	1,093,000	634,056
Montana	90,235	2,797,000	1,650,398
New Mexico	16,330	392,000	223,394
Utah	28,491	1,059,000	582,177
Washington	104,392	3,497,000	1,643,652
Total	26,431,369	523,621,000	222,048,486

The bushel value of the present crop has been exceeded but once during the past decade, in 1881. In that year the yield was only slightly below the average for ten years, and the crop was one of generous proportions. The price was high because of the short corn crop, admirably illustrating the relations between the two grains. The rapid enlargement of the area devoted to oats is shown by the fact that the average breadth between 1880 and 1890 is more than double that between 1870 and 1880. A slight diminution in the rate of yield, however, has prevented the average product from doubling during the same period.

Years.	Total production.	Total area of crop.	Total value of crop.	Average value per bushel.	Average yield per acre.	Average value per acre.
	Bushels.	*Acres.*		*Cents.*	*Bushels.*	
1880	417,885,380	16,187,977	$150,243,565	36.0	25.8	$9.28
1881	416,481,000	16,831,600	193,198,970	46.4	24.7	11.48
1882	488,250,610	18,494,691	182,978,022	37.5	26.4	9.89
1883	571,302,400	20,324,962	187,040,264	32.7	28.1	9.20
1884	583,628,000	21,300,917	161,528,470	27.7	27.4	7.58
1885	629,409,000	22,783,630	179,631,860	28.5	27.6	7.88
1886	624,134,000	23,658,474	186,137,930	29.8	26.4	7.87
1887	659,618,000	25,920,906	200,699,790	30.4	25.4	7.74
1888	701,735,000	26,998,282	195,424,240	27.8	26.0	7.24
1889	751,515,000	27,462,316	171,781,008	22.9	27.4	6.26
1890	523,621,000	26,431,369	222,048,486	42.4	19.8	8.40
Total	6,367,579,390	246,395,124	2,030,712,605	.....	.....	.....
Average, 11 years, 1880 to 1890	578,870,854	22,399,557	184,610,237	31.9	25.8	8.24
Average, 10 years, 1880 to 1889	584,395,839	21,996,376	180,866,412	30.9	26.6	8.22
Average, 10 years, 1870 to 1879	314,441,178	11,076,822	111,075,223	35.3	28.4	10.03

FARM ANIMALS.

The annual estimates of increase or decrease in farm animals are made in January, and are published in the January-February report, which has not been prepared, the annual going to press much earlier than usual. These estimates will be found in that report, which will be issued in February. The winter of 1890–'91 was unusually severe in the range regions, especially in Northern latitudes and on the Pacific coast, though the season east of the Missouri was one of extraordinary mildness. The losses in Washington and Oregon were very heavy, according to information apparently reliable, in some districts taking half to three fourths of all the cattle. The April report made the loss about two million cattle, and it is probable that the full depreciation was not revealed, especially as to the Pacific slope. A considerable reduction in numbers of cattle is probable. The facts, as nearly as they can be approximated, will be indicated in detail in the first report of the Statistician in 1891, the issue for January-February.

DISTRIBUTION OF DOMESTIC ANIMALS.

The increase in the commercial movement of farm animals during the past twenty years is one of the most striking facts in the commerce of agricultural products. It suggests a large increase in meat production and an advance in the rate of domestic consumption.

CATTLE.

The receipts of cattle at Chicago, Kansas City, St. Louis, and Omaha are more than three times as large as fifteen years ago, and have increased more than 70 per cent in five years. The increase exceeds 2,300,000, while the increase in exportation is only about 260,000, or including increase of meat exportation about 1,000,000 beeves, leaving nearly three fourths of the increase for home consumption. The total exports of 1889–'90, in beeves and beef, were little short of 1,000,000 animals, much above the average of our beeves in condition.

Receipts and shipments of Western markets.

Years.	Chicago.		St. Louis.		Kansas City.		Omaha.	
	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.
1870	532,964	391,709	201,422	129,748	21,000	No record.	.....	.....
1875	920,843	696,534	335,742	216,701	174,754	126,262	.....	.....
1880	1,382,477	886,614	424,720	228,879	244,709	194,421	.....	.....
1885	1,905,518	744,093	386,330	233,249	506,627	402,381	114,163	83,233
1886	1,963,900	704,675	377,550	212,958	490,971	370,350	144,457	73,130
1887	2,382,008	791,483	464,828	277,419	669,224	483,372	235,728	151,419
1888	2,611,543	968,385	546,875	336,206	1,056,086	682,622	340,469	206,064
1889	3,023,281	1,259,971	508,190	297,879	1,220,343	744,510	467,340	227,221
1890	3,484,280	1,260,309	639,014	361,225	1,472,229	923,552	606,699	283,880

Comparing receipts and shipments, we find a decrease in the proportion of shipments, due to the great development of the dressed meat trade, which increases the proportion slaughtered in the West. The use of the refrigerator car has wrought a great change in the methods of transportation of meat, both to the Atlantic seaboard

and to Europe. The rapid increase of the entire movement is a suggestive fact in the history of our agriculture. The aggregates of these primary markets are as follows:

Years.	Receipts.	Shipments.	Years.	Receipts.	Shipments.
1870	755,386	521,457	1887	3,751,783	1,703,693
1875	1,431,389	1,039,497	1888	4,554,973	2,193,277
1880	2,051,906	1,309,914	1889	5,219,154	2,530,281
1885	2,912,623	1,462,956	1890	6,202,222	2,828,965
1886	3,976,378	1,361,103			

Receipts of Eastern cities.

Years.	New York.	Boston.	Philadelphia.	Baltimore.	Total.
1870	361,076	124,592	126,738	89,021	701,427
1875	457,057	145,285	152,830	112,679	867,851
1880	679,987	230,079	218,606	138,969	1,267,641
1885	562,447	112,995	194,644	90,870	960,956
1886	513,470	113,316	176,025	96,357	899,168
1887	498,048	99,584	122,297	85,166	796,495
1888	515,593	124,416	134,574	170,113	944,696
1889	638,937	167,342	150,482	205,479	1,162,240
1890	684,502	167,974	.....	219,009	.....

SHEEP.

The enlargement of the movement of sheep is also very rapid, indicating great increase in consumption, which is quite out of proportion to increment of population. The following statement is from the records of the four centers of distribution, Chicago, St. Louis, Kansas City, and Omaha:

Receipts and shipments of Western markets.

Years.	Chicago.		St. Louis.		Kansas City.		Omaha.	
	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.
1870	349,853	116,711	94,477	11,049	.....	.....	.....	.....
1875	418,948	243,604	125,679	37,774	25,327	17,742	.....	.....
1880	335,810	156,510	205,969	93,522	50,611	36,285	.....	.....
1885	1,003,598	260,277	362,858	233,391	221,801	115,755	18,985	8,408
1886	1,008,790	266,912	338,985	202,728	172,659	83,234	40,195	17,728
1887	1,360,862	445,094	417,425	287,018	209,956	103,126	76,014	56,444
1888	1,515,014	601,241	456,669	316,676	351,050	169,932	158,503	118,208
1889	1,832,469	711,315	358,495	255,375	370,772	174,851	159,503	103,250
1890	2,182,667	929,854	358,506	252,151	535,869	336,207	156,186	94,464

The following are the aggregates of these records of receipts and shipments:

Years.	Receipts.	Shipments.	Years.	Receipts.	Shipments.
1870	444,330	128,360	1887	2,064,257	891,633
1875	569,954	299,180	1888	2,481,236	1,206,057
1880	592,390	286,317	1889	2,721,239	1,244,791
1885	1,607,242	617,831	1890	3,233,228	1,612,676
1886	1,550,629	570,602			

Receipts of Eastern cities.

Years.	New York.	Boston.	Philadelphia.	Baltimore.	Total.
1870	1,463,878	450,997	682,000	175,000	2,771,875
1875	1,233,968	372,370	491,500	191,485	2,289,323
1880	1,656,965	476,785	623,494	248,047	3,005,281
1885	1,849,277	639,847	616,573	178,712	3,284,409
1886	1,997,751	524,089	583,579	219,645	3,125,064
1887	2,025,116	591,476	588,279	227,456	3,432,327
1888	1,882,763	538,490	594,612	438,910	3,454,775
1889	1,805,805	540,460	537,431	421,951	3,305,647
1890	1,798,615	583,545	.....	381,025	.....

SWINE.

The effort in foreign countries to increase home supplies of swine, aided by tariffs and edicts of exclusion, has prevented the extension of our foreign trade, and for a time reduced its volume. The exports of 1889–'90 have nearly reached the highest limit of ten years ago. The record is as follows:

Receipts and shipments of Western markets.

Years.	Chicago.		St. Louis.		Kansas City.		Omaha.	
	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.
1870	1,693,158	924,453	310,850	17,156	36,000	No record.	.....	.....
1875	3,912,110	1,582,643	628,569	126,729	63,350	15,790	.....	.....
1880	7,059,355	1,394,990	1,840,684	770,769	676,477	152,920	.....	.....
1885	6,937,535	1,797,446	1,455,535	789,487	2,358,718	801,162	130,867	71,919
1886	6,718,761	2,090,784	1,264,471	530,362	2,264,484	538,005	390,487	187,369
1887	5,470,952	1,812,001	1,052,240	324,745	2,423,262	524,492	1,011,706	140,726
1888	4,921,712	1,751,829	929,230	294,869	2,008,984	413,937	1,283,600	333,228
1889	5,988,526	1,786,659	1,120,930	420,310	2,073,910	331,434	1,206,605	179,916
1890	7,663,828	1,985,700	1,359,789	667,832	2,865,171	558,227	1,673,314	275,638

Years.	Receipts.	Shipments.	Years.	Receipts.	Shipments.
1870	346,850	17,156	1887	9,958,160	2,801,964
1875	4,604,029	1,725,162	1888	9,143,526	2,793,863
1880	9,576,516	2,318,679	1889	10,389,971	2,718,319
1885	10,882,655	3,460,014	1890	13,562,102	3,487,397
1886	10,638,203	3,346,520			

Receipts of Eastern cities.

Years.	New York.	Boston.	Philadelphia.	Baltimore.	Total.
1870	889,625	189,330	189,500	300,000	1,568,455
1875	1,388,517	331,989	243,300	279,631	2,243,437
1880	1,719,137	691,839	346,960	336,867	3,094,803
1885	1,919,063	790,332	326,456	265,381	3,301,232
1886	1,980,656	930,787	333,849	323,643	3,568,935
1887	1,791,531	1,039,692	329,561	504,619	3,665,403
1888	1,549,837	1,063,827	344,719	613,959	3,572,342
1889	1,761,623	1,143,314	401,424	702,966	4,009,327
1890	2,126,446	1,231,173	.....	837,167	.....

PROGRESS OF AMERICAN DAIRYING.

The only general enumeration of cows is that of the United States. A few of the States report assessors' returns, which are more or less complete. That of the United States includes only cows on farms, and not those in towns and villages. The real number of cows in the country is therefore the number returned by the census plus the number not on farms or ranches, and plus the omissions of the enumeration, which are probably not large in this case.

The census returns of product did not include milk sold in 1850 and 1860, and only butter and cheese made on the farm. Butter factories were then practically unknown, and cheese factories in process of organization, and not included in census schedules. The amount of milk sold for all purposes, from farms, was relatively small, yet some allowance should be made for it in comparing the dairy products, especially with reference to aggregate milk production of the census years.

In this comparison the butter and cheese are reduced to milk, on the basis of 3 gallons of milk to 1 pound of butter, and $1\frac{1}{6}$ gallons of milk to 1 pound of cheese. The best dairies do a little better than this, but the average of all, including farm dairies, is so near these figures that it is impracticable to make any reduction from them. Even in the New York dairy tests the churnings of selected dairies in the local conferences, which are really perambulating dairy schools, the averages range from 15 to more than 30 pounds, and in 1889 averaged 21.04 pounds. Selection and breeding have considerably reduced the ratio of milk to butter in the best dairies during the past thirty years, which, unfortunately, are in so small proportion to the whole number of cows that the general improvement is slow. The census records of butter and cheese are thus reported:

Years.	Butter.			Cheese.		
	Farm.	Factory.	Total.	Farm.	Factory.	Total.
1850	313,345,306	.....	313,345,306	105,535,893	.....	105,535,893
1860	459,681,372	.....	459,681,372	103,663,927	.....	103,663,927
1870	514,092,683	.....	514,092,683	53,492,153	109,435,229	162,927,382
1880	777,250,287	29,421,784	806,672,071	27,272,489	215,885,361	243,157,850

Reducing the butter and cheese to milk, and adding 235,500,599 gallons of milk sold to factories and milk dealers, according to the census of 1870, and 530,129,755 gallons thus returned by the Tenth Census, the following aggregates of milk and averages per cow are obtained:

Years.	Cows.	Gallons of milk.	Gallons per cow.
1850	6,385,094	1,063,161,127	167
1860	8,585,735	1,499,985,364	175
1870	8,935,332	1,840,186,160	206
1880	12,443,120	2,893,698,520	233

These figures must not be received as the actual average yield of milk per cow, because the milk aggregate does not include that used

in the form of milk in the families of farmers. This factor in the problem can only be determined approximately. The proportion is smallest in the great dairy sections and largest in the States where butter and cheese are made in small quantities. In New York it has been estimated on the basis of the milk of one cow to each farm, which would give nearly the product of five cows for the markets to one for home consumption. As the dairy cows yield more than the farm cows, it might be fair to consider the ratio as six to one. On this basis the milk in products sold in New York in 1879 was equivalent to 401.6 gallons per cow, the milk used 66.9, making the total per cow 468.5 gallons. There should be a slight improvement in ten years in a portion of the stock, while there may be none in a much larger portion. Less than 2 per cent improvement would bring the average up to 475 gallons per cow, which is the maximum probability.

In some States, where cows are relatively few and the rates of yield small, at least two or three times as much milk is used in the natural form as is converted into butter and cheese. A definite estimate may not be practicable, but on the assumption that one fifth of the milk produced is consumed as such on the farm, the average yield per cow in 1880 would be about 291 gallons. This would make the milk product of farms 3,617,123,150 gallons. Add to this the milk of cows in villages and towns and the total probably exceeds 4,000,000,000 gallons. This refers to the milk of 1880. At the present time, with 16,000,000 to 17,000,000 cows—as there must be if all are counted—the aggregate milk produced undoubtedly approximates 5,000,000,000 gallons.

The prominence of a few States in dairying is presented strongly by the fact that ten States produce about two thirds of the butter and include more than half of the cows of the United States.

In the summary of products a remarkable change appears in cheese. In 1870 there was reported a product of 109,435,229 pounds, made in factories, in addition to 53,492,153 pounds made on farms. The farm product of 1860 was 103,663,927 pounds, which was all the cheese reported. In 1880 the farm product was still further reduced to 27,272,489 pounds, but the factory product was increased to 215,885,361.

In 1860 the factory system of cheese making, or associated dairying, began to attract general attention. Factories were in operation in Oneida County, New York. The system was originated by Jesse Williams, a farmer living near Rome in that county. He was an expert cheese maker and his product was eagerly sought by dealers, being far superior to the make of neighboring farms. The idea of the factory was accidental. Mr. Williams had contracted his cheese and that of his son, who had just entered upon dairying on another farm, at 7 cents per pound, a figure above the prevailing price. The son doubted his ability to make cheese of the desired quality, and it was finally arranged that he should bring his milk to his father's dairy. This suggested the thought that the neighbors might also bring their milk, which soon led to the erection of a factory building, and proved to be the pioneer of the cheese factories, which now represent the American system of coöperation in dairying. In 1854 a few more factories were built, and from two to four each succeeding year, until 1860, when seventeen were added to the twenty-one already in existence. In 1866 the number had increased to five hundred in New York, the larger number being built in 1863 and 1864.

As indicated heretofore, the census returned only butter and cheese in 1850 and 1860, the milk sold from farms being almost inappreciable in amount except in the vicinity of large cities. Since the rise

of associated dairying, the milk sold to factories, with that distributed for consumption in families, has added another item to the census count, that of milk sold. Reducing the butter and cheese to milk equivalents and adding milk sold, the milk produced per cow has been as follows:

States and Territories.	1880.		1870.		1860.		1850.	
	Number of cows.	Average yield per cow.	Number of cows.	Average yield per cow.	Number of cows.	Average yield per cow.	Number of cows.	Average yield per cow.
		Galls.		*Galls.*		*Galls.*		*Galls.*
Maine	150,845	314.2	139,259	270.2	147,314	252.3	133,556	228.9
New Hampshire	90,564	313.8	90,583	234.5	94,880	247.4	94,277	261.6
Vermont	217,033	387.3	180,285	349.5	174,667	328.0	146,128	318.8
Massachusetts	150,435	396.2	114,771	327.4	144,492	215.0	130,099	249.7
Rhode Island	21,460	323.0	18,806	258.6	19,700	166.3	18,698	179.5
Connecticut	116,319	325.4	98,889	290.9	98,877	277.2	85,461	301.3
Total	746,656	353.9	642,593	300.5	679,930	264.3	608,219	268.7
New York	1,437,855	401.6	1,350,661	358.2	1,123,634	325.7	931,394	319.3
New Jersey	152,078	289.9	133,331	226.6	135,818	233.1	118,736	248.3
Pennsylvania	854,156	322.8	706,437	280.6	673,547	265.6	530,224	231.1
Total	2,444,089	367.1	2,190,429	325.2	1,935,999	298.1	1,580,284	284.0
Delaware	27,284	247.9	24,082	177.5	23,595	190.3	19,248	164.7
Maryland	122,907	231.3	94,794	174.8	99,463	158.9	86,856	131.5
Virginia	243,061	147.0	188,471	113.0	330,713	123.1	317,619	106.3
Total	393,252	177.2	307,347	137.1	452,771	134.3	423,723	114.2
North Carolina	232,133	95.4	196,731	66.1	228,623	62.4	221,799	56.6
South Carolina	139,881	70.5	98,693	46.9	163,938	58.2	193,244	46.3
Georgia	315,073	72.0	231,310	58.9	299,688	54.5	334,223	41.8
Florida	42,174	26.2	61,922	4.9	92,974	13.3	72,876	15.6
Total	729,261	76.5	588,656	53.6	785,223	52.7	822,142	44.5
Alabama	271,443	89.4	170,640	57.1	230,537	78.5	227,791	53.0
Mississippi	268,178	85.0	173,899	45.2	207,646	72.4	214,231	61.0
Louisiana	146,454	20.6	102,076	17.8	129,662	33.5	105,576	19.4
Texas	606,176	71.0	428,048	26.3	601,540	29.7	217,811	32.8
Arkansas	249,407	95.1	128,959	64.3	171,003	71.5	93,151	60.1
Tennessee	303,900	180.3	243,197	120.5	249,514	121.1	250,456	98.3
Total	1,845,558	93.0	1,246,819	54.7	1,589,902	61.5	1,109,016	58.2
West Virginia	156,956	183.5	104,434	146.7	.....	.....	.....	.....
Kentucky	301,882	189.5	247,615	149.9	269,315	131.4	247,475	121.6
Ohio	767,043	328.8	654,390	279.0	676,585	252.5	544,499	234.4
Indiana	494,944	241.0	393,736	177.8	363,553	153.0	264,554	138.4
Illinois	865,913	239.7	640,321	186.5	522,634	165.2	294,671	182.6
Total	2,586,738	257.1	2,040,496	208.0	1,831,987	190.0	1,371,199	173.2
Michigan	384,578	324.7	250,859	304.0	179,543	269.7	99,676	224.5
Wisconsin	478,374	267.3	308,377	231.3	203,001	207.5	64,389	176.7
Minnesota	275,545	216.3	121,467	239.1	40,344	225.7	607	5.4
Total	1,138,497	274.4	680,703	259.5	422,888	235.7	164,622	205.0
Iowa	854,187	215.0	369,811	228.5	189,802	194.6	45,704	147.9
Missouri	661,405	134.9	398,515	111.6	345,243	111.3	230,169	103.1
Kansas	418,333	160.0	123,440	125.8	28,550	116.1	.....	.....
Nebraska	161,187	186.6	28,940	164.7	6,995	142.0	.....	.....
Colorado	28,770	107.8	25,017	49.5	.....	.....	.....	.....
Total	2,123,882	175.6	945,723	159.1	570,590	139.7	275,873	110.6
California	210,078	274.2	164,093	192.4	205,407	52.8	4,280	0.5
Oregon	59,549	129.9	48,325	92.2	53,170	58.7	9,427	71.9
Washington	27,622	160.1	16,938	74.6	9,660	49.0	.....	.....
Nevada	13,319	88.3	6,174	64.2	947	24.4	.....	.....
Total	310,568	228.4	235,530	160.0	269,184	54.0	13,707	49.6

States and Territories.	1880.		1870.		1860.		1850.	
	Number of cows.	Average yield per cow.	Number of cows.	Average yield per cow.	Number of cows.	Average yield per cow.	Number of cows.	Average yield per cow.
		Galls.		*Galls.*		*Galls.*		*Galls.*
Arizona	9,156	27.2	938	25.7	.....	.....	.....	.....
Dakota	40,572	159.3	4,151	152.1	286	22.8	.....	.....
District of Columbia	1,292	433.1	657	212.4	639	88.4	813	57.6
Idaho	12,888	75.7	4,171	84.1	.....	.....	.....	.....
Montana	11,308	116.5	12,432	109.3	.....	.....	.....	.....
New Mexico	12,955	12.1	16,417	4.3	34,369	2.4	10,635	0.7
Utah	32,768	105.6	17,563	58.3	11,967	84.4	4,861	58.9
Wyoming	3,780	106.1	707	12.1	.....	.....	.....	.....
Total	124,619	108.9	57,036	63.3	47,261	24.5	16,309	20.8
Grand total	12,443,120	232.5	8,935,332	205.9	8,585,735	174.7	6,385,094	166.5

In examining this table it shonld not be forgotten that the milk used as such on farms is not included. This might be, in New York, one sixth as much as that manufactured and sold, and in some of the non-dairying States a still larger proportion than that manufactured and sold. After making all possible allowances, there will still be a great difference between the yields of different States, ranging from 470 gallons in New York to less than 170 gallons in some of the Southern States.

It is a noticeable feature of this table that the yield increases from decade to decade. It is evident that the advance is not due entirely to the increasing accuracy of the returns, or to the milk sold introduced into the later enumerations. The attention given to selection and breeding has increased the rate of yield, and to some extent the proportion of butter-fats. The relation of milk to butter varies widely in different breeds, and in individual cows of the same breed. The experience of Hon. Zadoc Pratt, thirty years ago, affords a good illustration of this fact, and of the low average butter yield of the unimproved farm cows of that period. His farm was a large one of 365 acres, formed originally from hemlock clearings among the hills of the northwest corner of Greene County, near Delaware. In 1857, with selected cows averaging 636 gallons, the average milk to 1 pound of butter was 39.2 pounds. He saw the necessity of getting cows with richer milk, and his average was 32.33 to 1 the next year, and 29 in the year following. In 1860 the ratio was 23.3 to 1, and in following years successively 21, 19.7, and 20 pounds. The quantity of milk per annum was slightly reduced, but the yield of butter was nearly doubled.

The most hopeful and promising effort looking to practical results in the education of the future butter makers of the farm is the modern dairy school. New York has instituted a series of "dairy conferences," which continued last year through the summer, from May 30 to November 15, under the instruction of Messrs. W. H. Gilbert, F. D. Curtis, E. S. Munson, and H. Cooley Greene. There were twenty-nine meetings held, at which two or three examples of butter making were given, with rarely less than 200 pounds of milk at each, 69 churnings averaging 319 pounds, and yielding 1 pound of butter to every 21.04 pounds of milk. Many important points are illustrated by these ever-varying results. The wide differences in butter yield of different dairies, of different breeds of cows, and in

individuals of the same breed are illustrated distinctly and impressively in these tests. The great disparity in time required for churning, the various temperatures of the milk in creaming and of the cream in churning, the implements and appliances for setting the milk, the rations fed and methods of feeding, furnish themes for discussion and originate suggestions for thought and study, and lead to questions not easily answered and problems of science and practice not readily solved.

When such a series of conferences includes a churning which produces a pound of butter for less than 13 pounds of milk, while another requires more than 32 pounds of milk to make one of butter, it suggests in the latter case the prompt services of a butcher or the ultimate necessity for a mortgage or a sheriff's sale. As might be expected, the Jerseys led in butter product; six of the churnings were of pure Jersey milk, one producing a pound of butter for 12.77 pounds of milk and another a pound for 19.5 pounds, the average being 15.88 pounds. The Jersey grades were nearly as good, in only one instance a low grade requiring 20 pounds, and in one case less than 15 pounds. The natives were variable, some of them excellent, one requiring only 19 pounds, while one required 32 pounds. It is costly ignorance which feeds and milks and shelters two cows without knowing that more butter can be produced at the cost and care of one.

These dairy schools should offer to every ambitious boy and girl of the farm dairy a practical and ample curriculum of economic science. They are as yet only germs of the good of which they are capable when enlarged and perfected as they may be in the future.

THE DOMESTIC FOOD SUPPLY.

Relative to the prospective food supply there are two classes of extremists, optimists and pessimists, each enforcing conclusions by statistics. One maintains the theory of the possibility of practically unlimited food production, and the desirability, both from pecuniary and philanthropic considerations, of "feeding the nations of the world," thus preventing a glut in our own markets and such a fall in prices as to destroy all profit in production. The other claims that consumption is overtaking production, and will soon require foreign aid in maintaining supplies. Now in certain products in years of abundant yield, there has been such a surplus as to render unprofitable the labor of cultivation, and at the same time there has been an insufficient supply of other food products always grown here, and a failure to produce still others which might be, and which are now imported. So there is a color for each claim. But a broad statement of either view is unsupported by the logic of current agricultural statistics.

It is easy to draw hasty conclusions from such statistics, especially from the extraordinary data of the past thirty years, which are sure to prove unreliable and misleading. The abnormal demand arising amid civil war; the impelling force of high values during the cotton famine in pushing the extension of cotton area; the inflation of a subsequent period, ending in collapse; the remarkable era of cereal dearth in Western Europe; all these and other influences tended to general increase of product, with occasional fluctuations. Hence it has been easy to draw deductions which the facts of the future can

not be depended on to sustain. Twenty-one years ago veteran planters maintained in elaborate argument that 3,000,000 bales of cotton could never again be grown, but the fact refuted the prophecy in a single year, and the product has now passed 7,000,000 for several years. Others insist that the limit of area and product of wheat has been reached, because the breadth of nearly 40,000,000 acres of six years ago has not been maintained, and the product of 1890 is scarcely four fifths as much as that of 1884. The fact is too easily forgotton that areas fluctuate in obedience to changes of value; that flocks are slaughtered while herds are enlarged, and *vice versa*, as prices of meat and wool go up or down. One can with difficulty foretell what may happen in American agriculture, even when he knows all the circumstances which shall affect its results. The comparative stability of crop areas and rotations of some European countries is not to be expected in the United States, where rotation is almost unknown, and prospective profit controls the annual distribution. This fact injects an element of difficulty and uncertainty into statistics of agriculture.

While the public land areas are greatly reduced, and the proportion of improved lands of the older States is larger than ever, it is perfectly safe to assume that there is no ground for the pessimistic theory that our lands have all been taken up, that fertility is declining, that cultivation can not be extended, and foreign aid must be sought to meet the wants of advancing population.

The old tale of the wheat movement westward, as a sort of John Gilpin cereal race for the goal of the Pacific coast, with the Genesee Valley as a starting point, has been told and retold, though it has no more point now than when it was first presented. The sole meaning of the movement is that the pioneers of agricultural settlement have been wheat growers, and exclusive wheat growing has been the advance guard of agricultural forces in this country, keeping even step with progressive movement along the westering path of settlement. The country left behind grows as much wheat as before, the country nearest sunset grows all the more, and so the rapidly increasing aggregate is made to meet the wants of advancing population. The old area requires variety in cropping, and, if held by an intelligent yeomanry, gains in fertility by rotation and fertilization; the new must be subdued with the least labor and capital, a requirement which is met by wheat, a cash crop, which bears transportation better than any other cereal product. This explains why the center of wheat growing has moved gradually westward until it has reached the Mississippi River, but it does not prove that the soil is exhausted, that the area of Eastern productive land has reached its limit, that the rate of yield of farm products has attained its maximum, or that farming can no longer be profitable east of the Mississippi. More of the Eastern farm land will be made productive, and larger yields will be obtained by higher skill and more scientific methods.

The scale of living of farmers and others has been greatly advanced during the past fifty years. The supply of wheat in proportion to population has been nearly or quite doubled, some of it exported, but also much more consumed per head than formerly. In 1849 the production was 4.33 bushels per head; in 1879 (and again in 1884), 9.16 bushels. The increase of population in this period of thirty-five years was about 140 per cent, while the increase in wheat production was 410 per cent. This was abnormal, in part due to temporary demand of extraordinary proportions. It will not do to base

deductions of future wheat production upon irregular and unusual data; nor, on the other hand, is it safe to assume that our farmers will not supply a liberal domestic demand for a long time to come.

Corn, as a native American product, of nearly universal distribution, has always been in great abundance and wastefully profuse in consumption, yet the average per head of 25.5 bushels in 1849, has been increased, and in medium to abundant years averages from 30 to 33 bushels per head. As the exportation averages only 1 bushel in 25, the rate of consumption has materially increased.

So with many other products, meats especially. With an increase of rate of population that has excited the wonder of the world, there has been a material advance in consumption of food products and a corresponding increase in that of clothing. The following extracts from a nonofficial exposition of this question by the Statistician will throw further light upon this subject:

In the use of food our people are profuse and even wasteful. All classes use meats freely, ordinarily three times daily. A great variety of fish, oysters that have a fame extending beyond seas, and various forms of the crustacea enrich the national dietary. According to accepted statistics Great Britain consumes an average meat ratio not over two thirds as large as the American, France scarcely half as large, Germany, Austria, and Italy still less.

The American negro, even in the days of slavery, was usually allowed a weekly ration of 3 pounds of bacon and a peck of meal, besides vegetables and other products either of the plantation or his own garden patch. This made at least 150 pounds per annum, not to mention the occasional opossum and chicken that were respectively his legitimate game and his illegitimate plunder; and this amount of meat is more than the average consumption of any European nation, and two or three times as much as the average ration of several of them, including with the peasant and artisan, the citizen and nobility.

The average consumption of meat in the United States is probably not less than 175 pounds per annum. Of other civilized nations only Great Britain exceeds 100, and many of them scarcely average 50 pounds. The consumption of the cereals, by man and beast, is three times as much, in proportion to population, as in Europe. For the past ten years the average has been 45 bushels for each unit of population, while the usual European consumption does not vary greatly from 16 bushels per annum. While all is not used as food for man, no small part of it contributes to the meat supply.

The average consumption of wheat for bread is nearly 5 bushels, and about 3 bushels of maize and 1 bushel of oats and rye, or approximately 9 bushels for each inhabitant. The average European consumption of wheat is about 3.5 bushels. In the consumption of fruits the difference between this and other countries is marked with unusual emphasis. Small fruits, orchard fruits of all kinds, and tropical fruits, as well as melons of many varieties, are in profuse and universal daily use in cities and towns, and in the country the kinds locally cultivated are still cheaper and more abundant in their respective localities, though scarce in the regions of recent settlement and those unsuited to a wide range of species.

The consumption of vegetables is not excessive. The products that are rarest and dearest are those which are advancing in relative prominence in the dietary of the people. Variety and quality in food products are the points in which progress has been continuous and extensive. Not unfrequently skilled mechanics or miners, making high wages, are more fastidious and profuse in their marketing than citizens living upon the profits of capital. The abundance and variety of every form of food production, and the general distribution of means for procuring it lead to profusion and tend to wastefulness.

The American people are no less profuse in clothing than in food. This country is a favored land in fiber production. More than $400,000,000 is the comfortable sum which represents the present fiber products, in the form of cotton, wool, hemp, and flax. There is also experimental production of silk, ramie, sisal, jute, and many others suited to the climate, some of which will ultimately become the foundation of industries.

More than half of the material for the cotton factories of the world is grown here, and a third of that is manufactured and mostly consumed at home. If 65,000,000 people require one sixth of the cotton manufactured in Europe and America for the use of nearly 450,000,000 inhabitants of these continents, and of the millions in

India, China, Japan, and other countries obtaining supplies from the factories of Christendom, the disparity in consumption between this and other countries must be great indeed.

With an average per capita consumption of 17.5 pounds of cotton, 8.5 of wool, and a large quantity of silk, linen, and other fibers, the claim of superiority in supply of clothing can not well be disputed. Thus one twentieth of the population of the world consumes nearly a fourth of the wool product of the world. If the people of Europe should demand an equally liberal supply the earth might be scoured in vain for the requirements of such a consumption. As they do not, it may be supposed that a larger proportion of cotton would be needed; but a consumption equal to that of this country would not leave a pound for North or South America, Asia, Australasia, or Oceanica.* Indeed it would not suffice for more than a supply of 15 pounds per head to Europe alone.

Can this supply be kept up, or is the pressure of population on subsistence about to manifest itself? It would be a disgraceful imputation upon our agriculture to admit it. Scarcely more than a third of the South is included in farms, and the proportion of farm land in Maine is no larger. The land in the West is not all taken, and an immense area of arid lands can be irrigated and made highly productive. Then a considerable area of farm lands is not now utilized in production, and much of the tilled land is not half cultivated. High culture upon a scientific and common sense basis might increase materially if not double the present rate of yield. It will be time enough to talk of importation of food products when our population is five times as large as at present. The following extract further enlarges upon this theme:

With 9,000,000 farmers and farm laborers, cultivating over 5,000,000 farms, but a third of the land is taken up, but a small part of that is under crops, and the area under nominal cultivation is superficially treated and scarcely up to half its maximum production. There is nothing surprising in this. Cultivation is always primitive where land is cheap, before land speculation gives place to scientific agriculture. For this reason the richest lands are often found to give the lowest yields; for this reason the average wheat yields of the prairies of Iowa are less per acre than those of the granite hills of the East.

WAGES OF FARM LABOR.

It was thought possible that the wages of farm labor might be affected somewhat by the low prices of certain farm products—of corn and oats especially. This investigation is made in the spring, usually once in three years, but it was deemed advisable, on account of the complaints of low prices and hard times, to make the inquiry in 1890, though the previous one was instituted in 1888, and thus ascertain what effort, if any, had resulted in reduction of the rate of wages of labor.

The investigation showed no material decline in wages. Employers generally insisted that they were too high, and in many instances the tendency to reduce the amount of service was indicated; yet there was very little actual reduction, by no means enough to affect perceptibly the farm labor market. It is evident that the industries of the country are still in a comparatively prosperous condition, and that there is not a very large proportion of labor unemployed. Everywhere there is a pressure of competition with farm labor, withdrawing laborers from rural engagements and leaving to the remainder fair wages. In some places farmers complain that

* Ellison in his "Cotton Trade," makes the average weight of cotton goods consumed annually 5.68 per head. Belgium uses 9.8 pounds; Great Britain, 7.56; Germany, 7.53; Austria, 5.27; Italy, 5.06; Russia, 3.31, etc.

the more intelligent and skilled are withdrawn, and that they are compelled to pay higher wages than they can afford.

Farm wages in New England are slightly advanced as compared with the rates two years ago. Farm laborers prefer to go to the cities and find employment in cotton factories, machine works, shoe shops, or in other business. In northern districts lumbering, the ice business, and shipbuilding on the coast compete with farm work. There is much complaint of scarcity of intelligent labor.

Some report an abundance of foreign labor, which is characterized by many as unreliable. Laborers of this class require too much instruction and supervision.

In New York a similar scarcity exists. In some districts it is estimated that laborers obtain about one third more wages in other trades. This is natural and equitable, as the expenses of living are higher in towns. Farmers try to do their work with as little hired labor as possible, to avoid the expense of skilled labor and the annoyance of unskilled. They say that a majority of the laborers are looking for an "easy job." The demand for labor on railroads, at the oil wells, cement works, and in factories withdraws the more efficient laborers from the farms.

In New Jersey the usual manufacturing demand for labor is supplemented by the requirements of railroads, of watering places, of the oyster and clam business, and that of various fisheries.

Various causes of scarcity prevail in Pennsylvania. The coal and oil regions compete strongly, as do the furnaces and rolling mills, sawmills, bark mills, and various lumbering operations. Farmers say they can not afford to pay the wages which labor commands in these industries. Of course the feeding of the multitude otherwise makes a better demand and higher prices for agricultural products, with the limitation of the pressure of Western competition in the staples that can be readily transported long distances. Not a few counties, however, report a supply of labor equal to the demand.

In Delaware and Maryland there is also competition from factories, and from the oyster business on the eastern shore of Maryland, and from lumbering in the western mountain area. The Howard correspondent says: "It is abundant, but more worthless every year."

It is gratifying to note the activity of the demand for labor in mining and manufacturing, fisheries, and other industries, which has increased the rate of wages in Virginia, and made a demand for farm products. In some counties there is still a supply of farm laborers. In others a scarcity is noted. The tendency among young colored men to seek summer employment in Northern States is noted. Some farmers complain of its cost and decry its efficiency.

In the cotton States very few laborers are employed during the year at given rates in money. Those working on plantations prefer to work at shares of produce, under contracts greatly varying in terms. On the Atlantic coast there is a tendency to emigration westward, and also to working on shares. The turpentine business is moving down the coast and westward, causing the removal of able-bodied men from North Carolina, while those who remain, sometimes the women left behind, attempt to carry on farms, often running into debt with disastrous results. In South Carolina railroad enterprises and phosphate mining attract labor by higher remuneration. There is evidence of increased demand for labor in Georgia, Alabama, and Tennessee, in iron and coal mining, in fur-

naces and factories, and in other enterprises. It is an unusual experience, in the previous history of industry in Alabama, which the Hale correspondent indicates, "Most able-bodied men are working in mines, furnaces, and on railroads."

In one instance the abundant crop of last year is charged with producing a scarcity of labor, because while the means of the laborers hold out they will not work on farms.

In Mississippi there is in general a good demand for labor, as young white men leave the farms and become teachers or engage in mercantile pursuits, and colored laborers go to Louisiana or Texas, or to the swamp region, from the settled portions of the State. In the parish of St. Mary, Louisiana, labor is abundant and reliable, a good feeling existing between them and their employés. Labor is generally reported scarce in Texas, as the laborers wish to cultivate land of their own, either plantations cut up and leased on shares, or cheap lands in the western part of the State. In some parts of Texas it is said that farmers are "too hard pressed for money to have help," and that they "can not afford to borrow money at 10 to 12 per cent to pay for hired help." Labor here is augmented by immigration of Bohemians and Germans.

In Western Texas many Mexicans are employed. Much land is unoccupied in parts of Texas for want of labor to cultivate it. One correspondent refers to the negro as the best cotton maker, but indolent and content with a bare living. In Kaufman County "thousands of acres will be uncultivated this year from scarcity of hands." This scarcity and low prices have so discouraged farmers that they have mortgaged their farms to loan companies or abandoned them. There is a fruitful region in Arkansas, where labor is abundant, because the "small farms have more boys than tillable land or horses." Throughout the South it is easier to find transient or temporary labor, day labor, than regular employment by the month throughout the year.

Labor is somewhat scarce in West Virginia, owing to the activity of lumbering and coal-mining operations. In some counties in Kentucky labor is abundant, in others scarce, where laborers have gone into other industries. There is some complaint of lack of reliability.

There is abundance of work and plenty of workers in Ohio. The central county, Franklin, reports that "every man in the county can have work every day if he chooses." Yet there are local suggestions of deficiency as well as of abundance. It is held by some that from the farmer's standpoint, in view of the prices of products, farm labor is too high.

Many reporters in the West think wages are higher than the results of farming warrant, and that consequently farmers employ no more help than is absolutely necessary. There is in most places no real scarcity, yet a good demand exists, stimulated by competition, in lumbering, coal mining, railroading, and in the various industries of cities. Good help is scarcer than poor in the West as everywhere else. There is no difficulty in finding employment at fair wages for all skilled labor throughout the central valley region. In parts of Wisconsin the influx of Germans, Swedes, and Norwegians causes a superabundance of labor. One correspondent in Minnesota refers to the interesting fact that farmers' sons occupy their own land and thus reduce the demand for hired laborers. The self-binder has been a great boon in the harvesting of wheat, enabling the grower to do his work with fewer harvest hands. In many places farmers "change

work" with their neighbors, combining their forces for harvest work, and with the aid of their machines avoiding the employment of harvesters by the day. This has reduced the excessive wages formerly demanded by harvesters in the great wheat regions. In Howard County, Missouri, a superabundance of colored laborers is reported, who will not work on farms, and it is claimed that "a thousand good, honest white men and women can find pleasant homes at remunerative wages."

On the Pacific coast the use of farm machinery is reducing the number of laborers employed, and the rate of wages, though still higher than in other States, has been materially reduced. There seems to be a tendency towards ownership of land by laborers, which is reducing the number employed. There is considerable immigration into Oregon, which increases the supply of labor there. Labor is fully employed in the Rocky Mountain region and in some places it is scarce. There is great activity in business of all kinds in the arid region and great promise of future development.

The result of the whole investigation indicates a fair, if not full, employment of farm labor, at wages substantially the same as two years ago. It is suggestive and hopeful to note the increase of industrial activity in the South and West, more general and various than ever before, not only employing surplus rural labor, but making demand for the products of agriculture where they are grown. There is complaint of low prices of corn and oats, and thence in less degree of pork products, but wheat is higher than two years ago and meats about the same as at the former investigation. A bad season, which would reduce the corn crop 30 per cent, would increase its price 40 or more, and of oats nearly as much. The depression, therefore, is only partial and probably temporary, and has not reduced wages of farm labor, partly because there is still a firm demand for the best quality, and partly because of the general industrial prosperity, which has a favorable reflex influence upon agriculture.

The sectional averages for each period of investigation are as follows:

Sections.	1890.	1888.	1885.	1882.	1879.	1875.	1869.	1866.
Eastern States	$26.64	$26.03	$25.30	$26.61	$20.21	$28.96	$32.08	$33.30
Middle States	23.62	23.11	23.19	22.24	19.69	26.02	28.02	30.07
Southern States	14.77	14.54	14.27	15.30	13.31	16.22	17.21	16.00
Western States	22.00	22.22	22.26	23.63	20.38	28.60	27.01	28.91
California	35.50	38.08	38.75	38.25	41.00	44.50	46.38	35.75
Average, United States	18.38	18.24	17.97	18.94	16.42	19.87	.....	.....

There have been only slight fluctuations in the average rates of wages since 1879, the period of lowest depression, which followed an era of currency expansion, speculation, and nominal high prices. Leaving out the Southern States, where negro labor depresses the average, the average rate would be $23, which represents the wages of white labor more truly than the general average of the country.

WAGES PER MONTH BY THE YEAR.

The results of seven investigations, occurring at intervals between 1869 and 1890, are presented together in the following table, in which

the changes of twenty-one years in monthly wages are shown at a glance:

[Wages given in dollars.]

States and Territories.	1890.		1888.		1885.		1882.		1879.		1875.		1869.	
	Without board.	With board.	Without board.	With board.	Without board.	With board.	Without board.	With board.	Without board.	With board.	Without board.	With board.	Without board.	With board.
Maine	25.00	17.50	24.64	17.20	23.09	16.00	24.75	16.15	18.25	11.08	25.40	15.94	26.25	16.50
New Hampshire	25.15	17.60	24.38	17.00	22.80	15.75	25.25	16.72	19.75	12.80	28.57	18.25	32.66	22.16
Vermont	24.80	17.35	23.25	16.40	23.00	16.20	23.37	16.00	19.00	11.50	29.67	19.37	32.40	21.40
Massachusetts	30.00	18.50	29.50	18.00	28.75	17.85	30.66	18.25	25.00	15.33	31.87	20.25	35.95	22.15
Rhode Island	29.20	18.00	27.75	17.50	28.50	17.70	27.75	17.00	23.00	13.25	30.00	19.00	32.25	20.00
Connecticut	27.00	17.33	27.40	17.17	27.67	17.20	27.90	17.37	23.29	14.23	28.25	18.50	33.00	20.75
New York	24.45	16.65	24.13	16.30	24.00	16.52	23.63	15.36	20.61	13.19	27.14	17.80	29.28	18.64
New Jersey	25.10	16.00	23.33	15.73	23.60	14.10	24.25	14.20	20.22	11.53	30.71	16.78	32.11	19.02
Pennsylvania	22.80	14.60	22.24	14.50	22.52	14.12	22.88	14.21	19.92	11.46	25.89	16.10	28.68	18.05
Delaware	17.35	11.15	18.00	12.25	18.33	12.63	18.20	12.50	17.00	9.50	20.33	11.67	22.00	13.00
Maryland	17.67	11.25	18.48	11.84	18.20	11.50	16.34	9.89	14.00	8.95	20.02	11.42	21.55	12.00
Virginia	14.21	9.47	18.32	9.25	13.95	9.34	13.96	9.17	11.00	7.66	14.84	9.21	15.28	9.65
North Carolina	12.83	8.80	13.41	9.00	12.85	8.91	12.86	8.80	11.19	7.66	13.46	8.82	12.76	7.91
South Carolina	12.10	8.62	12.25	8.00	12.00	8.25	12.10	8.10	10.25	6.66	12.84	8.19	11.54	7.34
Georgia	13.13	8.37	12.60	8.81	12.47	8.73	12.86	8.70	10.73	7.38	14.40	8.79	14.70	9.70
Florida	19.35	12.59	18.00	11.33	17.80	11.37	16.64	10.20	13.80	8.73	15.50	10.75	16.10	10.91
Alabama	14.00	9.85	13.59	9.49	13.00	9.10	13.15	9.09	13.20	8.30	13.60	9.40	15.19	10.52
Mississippi	15.38	10.50	15.03	10.09	14.60	10.00	15.10	10.09	13.31	9.28	16.40	11.25	17.11	11.21
Louisiana	15.98	11.79	15.37	11.12	16.05	11.26	18.20	12.69	16.40	11.27	18.40	12.20	21.37	12.62
Texas	19.85	13.30	19.20	12.60	18.87	13.72	20.30	14.03	18.27	11.49	19.50	13.37	18.83	13.21
Arkansas	18.40	12.55	18.34	12.50	17.33	12.25	18.50	12.25	17.12	11.31	20.50	13.00	25.25	16.60
Tennessee	14.23	10.12	14.60	10.00	13.88	9.74	13.75	9.49	12.73	8.69	15.20	10.00	16.81	11.00
West Virginia	19.55	12.95	18.74	12.25	19.00	12.40	19.16	12.46	16.98	10.94	20.75	13.10	21.39	13.87
Kentucky	16.85	11.70	16.51	11.33	16.80	11.69	18.20	11.75	15.17	10.00	18.12	12.00	18.84	12.57
Ohio	22.10	15.10	22.21	15.00	23.00	15.50	24.55	16.30	20.72	13.84	24.05	16.33	26.35	16.74
Michigan	24.80	16.75	25.20	17.00	24.00	16.14	25.76	17.27	22.88	14.64	28.22	18.46	31.01	20.03
Indiana	22.25	14.78	22.50	15.30	22.20	15.30	23.14	15.65	20.20	12.76	24.20	16.14	25.42	17.03
Illinois	23.25	16.35	23.20	16.00	23.50	16.60	23.91	17.14	20.61	13.01	25.20	16.87	27.32	17.69
Wisconsin	24.35	16.75	24.65	16.80	23.54	16.78	26.21	17.90	21.07	13.81	25.50	16.45	30.08	18.47
Minnesota	24.60	16.60	25.75	17.68	25.50	16.75	26.36	17.75	24.55	15.62	26.16	16.36	28.61	17.94
Iowa	25.41	17.00	25.40	17.34	25.33	17.00	26.21	17.95	22.09	13.90	24.35	16.11	28.39	17.87
Missouri	20.25	14.00	21.00	14.20	21.35	14.50	22.39	13.95	17.59	11.84	19.40	13.15	24.47	16.38
Kansas	22.75	15.05	24.25	16.05	24.70	16.00	23.85	15.87	20.67	13.28	23.20	14.65	28.96	18.38
Nebraska	25.50	16.60	25.59	17.18	25.00	16.50	24.45	16.20	23.04	14.86	24.00	14.75	33.25	19.18
California	35.50	22.40	38.08	25.67	38.75	25.00	38.25	23.45	41.00	26.27	44.50	28.60	46.38	28.69
Oregon	31.60	22.00	32.56	23.00	34.00	21.25	33.50	24.75	35.45	23.86	38.25	25.67	.....	.....
Nevada	35.00	23.00	38.00	27.00	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Colorado	33.75	21.00	36.00	23.00	33.00	21.25	36.50	27.08	35.00	20.00	38.50	21.14	.....	.....
Arizona	33.00	21.50	25.00	16.00	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Dakota	24.75	17.10	25.85	18.21	25.55	17.60	.....	.....	28.56	16.57	32.50	20.50	.....	.....
Idaho	36.25	23.50	39.00	26.25	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Montana	36.50	23.80	40.00	27.50	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
New Mexico	27.50	17.83	28.75	18.25	28.75	17.50	.....	.....	22.10	13.80	22.75	14.25	.....	.....
Utah	32.30	21.00	33.50	22.30	30.00	21.00	.....	.....	28.87	20.50	35.50	25.33	.....	.....
Washington	37.00	24.40	35.20	25.00	38.33	26.25	.....	.....	.....	.....	.....	.....	.....	.....
Wyoming	34.00	23.00	37.00	25.00	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Average	18.33	12.45	18.24	12.36	17.97	.....	18.94	.....	16.42	.....	19.87	.....	.....	.....

FLUCTUATION OF AGRICULTURAL PRICES.

A statistical analysis of prices of farm products for twenty or thirty years does not warrant the idea that prices have suddenly declined, are much lower than formerly, or in unexampled depression. The tables of quotations of various products show great fluctuation, low rates in abundant years, high values in years of scarcity. The idea somewhat prevalent of a strong tendency to continuous decline is not sustained by the record. The downward tendency of prices of farm products during thirty years has been far less conspicuous than the decline of values of other products of human labor. This applies to

farm products as a whole, rather than selected crops and exceptional years.

To specify principal crops, corn for ten years, average farm value, has been about 40 cents per bushel. From 1870 to 1879 it was only 2 to 3 cents more, and in gold value no higher than for the recent decade. Even in the decade from 1860 it was no higher in gold. But fluctuations occur in each period, as in the last, when 28.3 and 63.6 cents represent the value of largest and smallest crops respectively. The prices of wheat have been higher for three years past than for the three preceding. From 1876 to 1880 they were much higher from the unexampled demand due to the crop failures of Western Europe. The average of Chicago prices for three decades, expressed in currency, are nearly the same in gold for each, though there are annual fluctuations. The export price of cotton for the last fiscal year was about 10 cents per pound, while the average for ten years is only 10.5 cents per pound. Prices during the civil war were of course higher. The current rate depends entirely on the quantity marketed. Beeves are within two or three points of the prices of the last five years, the price of wool is advancing, fruits and vegetables command usual prices, higher if scarce and lower if abundant. The sellers get all they can for their share, as usual, and have facilities for combination to enforce their demands, which are not perceptibly greater than for several years past.

Thus we find nothing in the prices of farm products, either current quotations or their course and tendency in recent years, to warrant the assumed existence of any sudden, extraordinary, or permanent fall in values of farm products. We find that some are higher than they have been and still improving; that the national crop, corn, which has been plethoric in quantity, and therefore low in value, is higher than at any time since 1881; that hereafter, as heretofore, demand will control price, and the grower who caters to a new and rising demand, grows some product of which there is no surfeit, will obtain a more generous remuneration for his labor. Foresight in this matter, a wise departure from the conservatism of routine, and aptitude for deftness and skill in new lines of effort, will bring better prices and better times.

THE PRICE OF CORN.

The fluctuation in the price of corn has been great. It is not difficult to account for it. Prices depend on supply. With a variation in the supply of 12 bushels per head, or from 23 to 35 bushels, it is not strange that the average farm price should be 63.6 per bushel in one case and 28.3 in the other. In extreme scarcity the advance in price is out of proportion to the decline in supply. A fall of 522 million bushels in 1881 sent the price up 24 cents per bushel. An increase of 422 million bushels the next year caused a fall of 15 cents. It would have gone lower but for the exhaustion of old corn during the previous year. The next crop, nearly as large, averaged 6 cents less, and with increase of product in the two succeeding years the value declined 10 cents, and again rose 12 cents in two more years in consequence of successive diminutions of product. Then came the two largest crops ever grown, depressing the value, first from 44.4 to 34.1, and then to 28.3. Succeeding this is the present crop of only 24 bushels per head, causing a jump to 50.6 cents, an increase of 77 per cent. What more is needed to show that with crops small

enough the highest prices ever known can be obtained without the slightest influence of the assumed tendency of the time to low prices?

The largest supply was in 1879, 1885, and 1889. In the former year the largest exportation ever known in corn and cornmeal and in pork products (to supply an alarming deficiency in Western Europe) aided in advancing the price heavily. In the latter two the values were 32.8 and 28.3, the lowest of the list, yet not equally depressed, for one reason because of the large production of oats in 1888 and 1889, which is a crop that supplements corn and influences its price.

Going to the other extreme, that of the highest price, 63.6 cents in 1881, the smallest crop of the period is found, about half that of 1889 in absolute quantity, but seven tenths as much in proportion to population. The supply per head was lowest at this time, and was apparently but little higher in 1887, when the price was only 44.4 cents, but really the quantity for home consumption was much greater, because the foreign exports of corn and pork products were so much reduced, leaving a larger supply for home use. Could the exports of grain and secondary products be eliminated from this supply per head, and the remainder of each year be incorporated with the next crop, the relation between quantity and price would be still more striking, leaving little allowance for other causes affecting prices. It is with corn as with wheat, prices were reduced by keeping up the relative supply, while the exports have fallen off. For five years the supply per head has been larger than for the previous five years, while the proportion exported as grain and pork and lard has been less. A continuous oversupply, though the excess be small, suffices to glut and demoralize the market.

The average requirement, while exceedingly flexible, because depending so much on the abundance of other feeding material, must be taken to be about 27 bushels to each unit of population. Perhaps the actual supply has been near 28 bushels, exclusive of exports. The average farm price for ten years has been 39.3 cents per bushel and for the preceding decade 42.6 cents.

Commercial prices in Chicago may be found on another page for the 1st of January in each year since 1860. Dividing into periods of ten years, and making a rough average of these January prices, a comparison can be made. The first period has an average of 56.3 cents per bushel, the second 43.6 cents, and the third 42.8 cents. The Chicago average for the last ten years is thus 3.5 cents less than the average farm price for the country, and the period ending in 1880 just 1 cent lower than the farm price for the same period. An analysis of these Chicago quotations shows that price depends on quantity. Thus, in 1862 it was 23 cents; in 1865 it was 88 cents. In 1879, after several years of abundance, it was 29.8 cents, but in 1875, after a short crop, it was 66.3 cents. So, in 1890, after the largest crop grown and one of the largest per head, the price was 29.3 cents, while in 1882, after a very short crop, the figure was 62.5 cents.

We can have corn at 30 cents or at 60 cents per bushel, if we can regulate the supply. Now, it would not be advantageous to farmers, in the long run, to keep corn at 60 cents, but it would equalize general prices and advance the general prosperity to keep it in the neighborhood of 40, or about the average of the last twenty years. This can be done by the farmers themselves, but only by restricing the supply to the requirements of the home market or increasing the foreign demand.

It is not asserted here that there are no other causes operative in modifying prices, but they are limited and obscure compared with the relative quantity of the supply.

The following table gives the average farm price of corn in the seven States having an annual surplus from 1876 to 1889, exclusive:

States.	1877.	1878.	1879.	1880.	1881.	1882.	1883.	1884.	1885.	1886.	1887.	1888.	1889.	1890.
	Cts.	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*
Ohio	40	33	39	41	61	62	47	41	32	35	48	35	31	51
Indiana	34	27	34	40	60	48	41	34	29	32	45	31	27	47
Illinois	29	25	31	36	58	47	40	31	28	31	41	29	24	43
Iowa	25	16	24	26	44	38	32	23	24	30	35	24	19	41
Missouri	27	26	25	36	65	39	35	26	25	31	37	30	23	44
Kansas	21	19	27	29	58	37	26	22	24	27	37	26	18	51
Nebraska	18	16	21	25	39	33	24	18	19	20	30	22	17	48
United States	35.8	31.8	37.5	39.6	63.6	48.4	42.4	35.7	32.8	36.6	44.4	34.1	28.3	50.6

The price in 1889 was lower in all these States than in any other year of this record, excepting that in Indiana, in 1878, it was the same and in the same year in Iowa and Nebraska a lower price was reached. There was discouragement and depression as a result of these low prices. The reduction was attributed by unthinking people to all sorts of extraneous causes, financial and political, and the great crop was divided up theoretically into daily individual rations to show how small an allowance it really was. While grumbling over the unremunerative prices, the untoward meteorology of 1890 was silently and surely working a cure for low prices. A glance at that statement of prices is a wonderful revelation of sudden advance. The average of Ohio jumps from 31 to 51 cents; Indiana, from 27 to 47; Illinois, from 24 to 43; Iowa, from 19 to 41; Missouri, from 23 to 44; Kansas, from 18 to 51; Nebraska, from 17 to 48. Never before was the price so high in Nebraska since the State was self-supporting. In Iowa, Missouri, and Kansas, only in 1881 were prices higher, and in Ohio, Indiana, and Illinois only in 1881 and 1882. So radical a change is not desirable, because the production in large districts beyond the Missouri is not sufficient for consumption, and only the best farmers there have any corn for sale; yet it is a harsh but irresistibly forcible illustration of the truth that prices still depend on the relation of supply and demand.

WHEAT PRICES.

The farm price of wheat has exceeded a dollar per bushel only one year in the past decade, and that was in 1881, the year of low yield so well remembered by all our farmers. A sharp fall occurred in 1884, a year of large production in this country, in Europe, and in India. In six years, from 1884, low prices have prevailed except in 1888, in which the product dropped heavily. Relatively the December value of the present crop was higher than that of 1887, and 9.3 cents higher than that of 1884. The present quotations of wheat are nearly up to the highest records of the past six years. There is nothing very depressing in current wheat values. The gradual reduction of stocks of old wheat, visible and invisible, promises continuance of higher prices. Prospects of larger products, good yields in other countries, would tend to hold at present rates or reduce somewhat the quotations of the future. Thus is the wheat grower's profit dependent on the friendly alliance of rust, blight, and insect depredations in other fields.

The States this side of the Rocky Mountains which cut a figure in the commercial distribution of wheat are found in the following table of average farm prices on the 1st of December of each year. The time includes the period of crop failure in Western Europe from 1876 to 1879, inclusive, which is responsible for the heavy exportation and high prices of this period. The high price in 1881 was due to a crop "failure" in this country. This period was the same in which our wheat acreage was so greatly enlarged. Since 1884 prices have been comparatively uniform, not to say uniformly low. The causes controlling these prices are as plainly visible as the bright rays of the morning sun, and the local differences indicated in the table are as plainly visible. Even the low ebb of last year's averages for Kansas and Nebraska is explained by abundance of home supply, distance from market, lack of facilities for handling and sale of surplus, and comparative lack of high favor for milling purposes, which operates so generally in Dakota and Minnesota.

The following table affords opportunity for study of local prices and their changes:

Average farm price of wheat for the years 1877 *to* 1890.

States.	1877.	1878.	1879.	1880.	1881.	1882.	1883.	1884	1885.	1886.	1887.	1888.	1889.	1890
	Cts.	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*
Ohio	124	86	120	102	129	95	99	75	91	74	75	97	76	91
Michigan	122	85	117	97	125	90	96	74	84	73	74	98	74	90
Indiana	113	81	117	99	127	90	95	67	86	70	72	94	71	88
Illinois	104	75	107	95	122	86	92	63	81	69	70	93	70	87
Wisconsin	98	67	104	100	119	90	88	60	76	68	64	96	70	83
Minnesota	91	51	94	87	106	82	80	50	70	61	59	92	71	81
Iowa	87	50	92	82	106	70	80	55	67	60	61	85	63	80
Missouri	100	67	101	89	119	85	88	62	77	63	62	88	64	88
Kansas	82	59	89	70	105	67	78	45	65	58	61	88	55	77
Nebraska	83	49	84	73	97	67	70	42	57	47	53	83	52	76
Dakota	.....	.....	.....	.....	.....	80	72	46	63	52	52	91	60	70
United States.	108.2	77.7	110.8	95.1	119.3	88.2	91	64.5	77.1	68.7	68.1	92.6	69.8	83.8

A record of Chicago Board of Trade prices on the 1st of January since 1860, which are herewith given, shows that the lowest price in thirty years was in 1862, when the quotation was 76.5 cents. The premium on gold made abnormal currency values for a dozen years and more, and caused a difference in price more apparent than real. The average of these January prices, by decades, is 128.6 cents per bushel in the first, 110.5 in the second, and 90.7 cents in the third. The difference in gold values is slight between these decade averages. Still there are annual fluctuations, caused by fluctuating supply of the world, in which our surplus exercises a large, if not controlling influence. For instance, since 1880 the range of quotations has been from 126.8 cents in 1882, to 75 cents in 1885. Only three years sufficed to make the change from the highest to the lowest. So the lowest 1st of January record in ten years was not in 1890, when the price was 78 cents, but five years ago. Last January's price was a little higher than that of 1885, but 22 cents lower than in 1889, and the only reason that dollar wheat was then marketed was the fact of a poor crop, a little better than that of 1881, which sent the January price (1882) to 126.8 cents.

If wheat growers should insist on growing 600,000,000 bushels, and at the same time demand a dollar per bushel, under existing conditions elsewhere, no exercise of power by the Government could

possibly guaranty such a market price, or prevent its reaching a lower depth than it has hitherto reached.

CHICAGO PRICES OF CEREALS.

The following table gives the Chicago prices of cereals from 1861 to 1890, inclusive, as reported by the Board of Trade on or about the 1st of January of each year.

[Prices given in cents per bushel.]

Years.	Corn.	Wheat.	Oats.	Rye.	Barley.
1861	28 to 28½	82 to 83	17 to 17½	45½ to 46	38 to 43
1862	23	76 77	18	32	35
1863	42 42¾	115	43 45	60	85
1864	47½ 48	126	66 66⅜	102½	121 122
1865	88	176	64⅜ 65⅛	112	125 135
1866	45 46	122½ 131	24½ 26	49 55	.....
1867	74⅜ 75⅛	193 200	41 42½	.....	.....
1868	86 86½	193 198	55 56½	.....	.....
1869	56	114 115½	45½ 47	114 119	162 168
1870	69 72	77½ 77¾	39½ 40	.....	.....
1871	43⅓ 44	109 111	39 39⅜	75 76	70 78
1872	40½ 40⅞	120½ 121⅜	31⅝ 32⅛	63½ 67½	60½ 63½
1873	30⅜ 31	119½ 125⅜	24½ 24⅝	66 68	64½ 65
1874	53½ 53½	117½ 118	38½ 39⅓	76½ 78	138 145
1875	66 66½	90½ 90¾	52⅜ 53	95 98	123 128
1876	43 45	95 96⅜	29⅞ 30½	65 67	78 80½
1877	43⅜ 44⅜	124⅜ 126½	33⅞ 34⅜	72 72½	64 67½
1878	42⅜ 43½	107⅞ 109⅛	24⅛ 24⅞	56 56½	57½ 58
1879	29½ 30	81⅝ 83	19½ 19⅝	43 43½	95 97½
1880	39⅜ 40⅜	130 132½	35	80½ 80⅝	82 85
1881	36 37½	95⅜ 98¼	30½ 31¼	85 88	112 115
1882	60⅞ 63½	125⅜ 127⅝	42⅜ 45	95½ 96	105 108
1883	49⅝ 54⅛	93½ 96	35 35⅜	57 58	85
1884	54⅓ 57⅜	93⅜ 95½	32⅓ 33⅞	58½ 59	61 62
1885	34⅛ 34⅞	72⅝ 78¼	25¼ 25⅞	73	61
1886	36⅛ 36⅛	84⅛ 85	28	58½ 59	65 66
1887	36½ 37⅜	78 80⅛	26¼ 26½	53	52 53
1888	48⅞ 49½	77 7	31⅜	62	83
1889	33⅜ 33¾	99½ 101	25⅛	50	.....
1890	29¼ 29½	77¾ 78⅓	20⅛ 20½	44½	.....

The following record of California prices of wheat (given for centals, but reduced to bushels of 60 pounds) was made by Albert Montpelier, manager of the Granger's Bank, San Francisco:

Years.	July.	August.	September.	October.	November.	December.	January.	February.	March.	April.	May.	June.
	Cts.	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*
1877–'78	136	134	139	140	138	142	134	122	117	119	115	101
1878–'79	100	102	104	103	102	102	101	101	99	97	98	99
1879–'80	101	101	105	118	122	122	117	115	116	102	95	92
1880–'81	90	87	80	87	91	87	82	79	80	82	83	83
1881–'82	82	92	100	101	103	99	99	98	98	97	100	101
1882–'83	102	101	99	99	100	101	108	114	116	106	105	98
1883–'84	95	101	102	101	109	110	105	97	95	92	91	87
1884–'85	83	79	72	75	75	76	78	77	77	84	86	84
1885–'86	85	83	85	89	84	83	81	77	78	81	79	77
1886–'87	75	78	80	81	83	89	94	90	94	103	107	119
1887–'88	113	.....	75	77	80	83	82	80	79	79	84	79
1888–'89	81	89	91	96	95	87	84	85	83	83	79	77
1889–'90	79	79	77	78	78	77	77	76	77	77	79	77

The very high prices of 1887, 36 cents higher in July than in July of 1878, followed a crop a fraction above 10 bushels per acre for the

whole country. It is seen that the averages for 1888–'89 were as high as those of the period 1886–'87 and 1887–'88 and higher than in 1885–'86.

The recent increase in prices.

Markets and items.	Unit of measure.	1889.				1890.				1891.	
		January 2.		July 1.		January 2.		July 1.		January 2.	
Portland, Me.:											
Corn	Bushel..	$0.57 to	$0.59	$0.50		$0.50 to	$0.51	$0.48 to	$0.49	$0.69 to	$0.70
Oats	...do	.40	.42	.40 to	$0.42	.34	.35	.40	.41	.56	.57
Potatoes	...do	.50	.60	.65	.70	.70	.75	.75	.85	.90	1.00
Hay, loose	Ton.....	12.00	15.00	14.00	17.00	14.00	17.00	12.00	14.00	12.00	14.00
Butter, creamery	Pound ..	.28	.32	.23	.25	.23	.25	.21	.23	.25	.28
Cheese, sage	...do	.14½	.15½	.14½	.15½	.12½	.13½	.12	.13	.12½	.13½
Eggs	Dozen ..	.27	.30	.16	.18	.25	.26	.16	.17	.29	.30
Lard, leg	Pound ..	.09	.10	.07¼	.08	.06¾	.07½	.06½	.07½	.07	.10½
Wool, fleece-washed	...do	.25	.28	.25	.28	.25	.28	.28	.30	.25	.35
Boston, Mass.:											
Corn, No. 2 mixed	Bushel..	.46		.46		.41	.41½	.44½			.64½
Oats, No. 2 white	...do	.35½	.36½	.35½	.36½	.32	.32¼	.37½			.55½
Rye	...do	.67		.60		.....		.65		.78	.80
Barley, 2-rowed State	...do	.80		.....		.55	.58	.72	.75	.85	.88
Potatoes, Holton Hebrons	...do	.58	.60	.....	.....	.70		.....		1.05	1.08
Hay, fair to good	Ton.....	16.50	17.50	17.00	17.50	14.00	15.00	14.00	15.00	13.00	14.00
Butter, extra dairy	Pound ..	.26	.27	.18		.22	.23	.15	.16	.24	.25
Cheese, Vermont extra	...do	.11¼	.12	.08½	.08½	.10½	.10½	.07½		.09¼	.10
Eggs, Eastern extra	Dozen ..	.23	.24	.17		.25		.16			.23
Lard, city rendered	Pound ..	.09	.09½	.07½	.07⅝	.6¼	.07	.06½	.06¾	.06¼	.06¾
New York:											
Wheat, No. 2 winter	Bushel..	1.02½	1.04⅝	.87½	.88½	.87	.87½	.95⅜	.96⅜	1.04¾	1.05½
Corn, No. 2 mixed	...do	.47¼	.48	.42¾		.40¼	.40⅜	.41¾	.42	.61¾	
Oats, No. 2 mixed	...do	.30⅞	.31½	.28⅝	.28¾	.28⅝	.28¾		.34	.49¾	.49½
Rye, State	...do	.60	.64	.52	.53	.56	.60	.56	.57½	.78	.80
Barley, 2-rowed, State	...do	.78	.80	.....		.51	.53	.....		.83	.85
Pork, prime mess	Barrel ..	14.25	14.50	13.25	13.50	10.00	10.50	13.25	13.75	11.50	12.00
Butter, State dairy	Pound ..	.27	.28	.17	.18	.21	.22	.15		.23	.25
Cheese, State factory	...do	.12		9	.09½	.10	.10½	.08½	.08½		.09½
Eggs	Dozen ..	.20	.21	.14	.14½	.23	.24	.15		.....	
Hay	100 lbs ..	.90	.95	.90		.80	.85	.85	.90	.55	.65
Tobacco, Connecticut leaf	Pound ..	.10	.20	.15	.25	.15	.25	.15	.25	.11	.23
Tobacco, Virginia wrapper	...do	.12½	.15	.12	.16	.12	.16	.12	.16	.10	.23
Philadelphia, Pa.:											
Wheat, winter	Bushel..	.97½	.98	.95		.81	.81½	.89½	.90	1.04	
Corn, No. 2 mixed	...do	.42⅝	.42⅜	.43½	.43½	.36	.36½	.41⅝	.42	.60	
Oats, No. 2 white	...do	.34	.34½	.33⅜		.29½	.30	.35½		.50½	
Hay, timothy	Ton.....	14.00	17.00	11.00	16.00	11.00	13.00	10.00	12.25	10.50	
Baltimore, Md.:											
Wheat, No. 2 red, winter	Bushel..	.95		.85⅝		.79½		.89		.96	
Corn, mixed	...do	.42		.41½		.36⅜		.41½		.57⅛	
Oats, No. 2 white	...do	.33		.34		.31		.35½		.50	
Rye, No. 2	...do	.58		.49	.50	.57		.55		.80	
Hay, timothy	Ton.....	16.00	17.00	15.00	15.50	12.50	13.50	11.00	12.50	9.50	11.00
Wool, tub-washed, fair to choice	Pound ..	.32	.35	.33	.38	.34	.36	.34	.35	.33	.35
Atlanta, Ga.:											
Wheat, winter	Bushel..	1.12		.....		.75		.....		.....	
Corn, white	...do	.58		.56		.52	.54	.57			.75
Oats, No. 2 mixed	...do	.40		.38½		.32	.34	.40			.59
Potatoes	Barrel ..	2.25		3.00		1.50		2.00			3.75
Hay	Cwt	1.05		.95	1.05	.90	.95	.90			.90
Beef, dressed	Pound ..	.05		.05⅜		.06	.06½	.06			.06
Cotton	...do	.09½		.10½		.09½	.09⅝	.11			.08½
Eggs	Dozen ..	.....		.12	.14	.22		.12½			.26
New Orleans, La.:											
Corn, No. 2 white	Bushel..	.46	.47	.48	.49	.39		.47			.64
Oats, No. 2	...do	.35		.33	.33½	.30		.37½			.54
Hay, prime	Ton.....	16.50	17.50	14.00	15.00	12.00	14.50	14.00	15.00	14.00	15.50
Pork	Barrel ..	14.25		13.00	13.25	10.37½		12.75			9.75

The recent increase in prices—Continued.

Markets and items.	Unit of measure.	1889.				1890.				1891.	
		January 2.		July 1.		January 2.		July 1.		January 2.	
Cincinnati, Ohio:											
Wheat, No. 2 red, winter	Bushel	$0.95 to $0.97		$0.88 to $0.90		$0.76 to $0.78		$0.85 to $0.87		$0.96 to $0.97	
Corn, No. 2 mixed	do	.34½	.35	.38	.38½	.30	.31	.37½	.38	.52½	
Oats, No. 2 mixed	do	.27½		.25	.25½	.23½	.24			.43½	.44
Rye, No. 2	do	.56½	.57	.44	.46	.46	.48	.50		.73½	.74
Potatoes	do	.30	.40	.25	.30	.30	.35	.40	.50	.95	1.00
Hay, timothy	Ton	13.50	14.00	11.50	12.00	10.00	11.00	9.00	10.00	9.00	9.50
Pork, mess	Barrel	13.50	13.62½	12.12½	12.25	9.50		13.00	13.75	10.00	10.12½
Butter, fancy creamery	Pound	.35		.18	.20	.29	.30	.18		.30	.31
Cheese, Ohio factory	do	.11	.11½	.07	.08	.09	.09½	.07	.08	.09	.09½
Eggs	Dozen			.11	.11½	.15		.10		.20	
Chicago, Ill.:											
Wheat, No. 2 red, winter	Bushel	.99½	1.01	.82½	.84	.77⅞	.78½	.85⅜	.88	.88½	.89½
Corn, No. 2	do	.33⅜	.33⅝	.35	.35¼	.29½	.29⅝	.35⅞	.34⅛	.48½	.49½
Oats, No. 2	do	.25⅛		.22⅝	.22⅞	.20⅛	.20⅜	.27⅞		.42	.42½
Rye, No. 2	do	.50		.42½	.43	.44½					
Hay, No. 1 timothy	Ton	11.00	11.50	10.00	11.00	9.00	10.50	10.00	11.50	9.00	9.75
Beef, extra mess	Barrel	6.00	6.25	6.25	6.50	5.75	6.00	6.00	6.25	5.50	5.75
Pork, mess	do	12.85	12.87½	11.70	11.75	9.10	9.12½	11.25	12.00	10.20	10.25
Eggs	Dozen			.12		.16	.17	.10	.10½	.22	
Milwaukee, Wis.:											
Wheat, No. 2 spring	Bushel	.95		.78⅜		.72½		.83		.83½	
Corn, No. 3	do	.31		.35¼		.28	.28½	.35	.35½	.47½	.48½
Oats, No. 2 white	do	.27½	.28	.27½		.22¼	.22½	.29½	.30	.42	.43
Barley, No. 2	do	.67		.50⅜		.47		.48½		.66½	
Rye, No. 1	do	.49⅜	.50	.43½		.45		.48½		.67	
Potatoes	do	.30	.35	.25	.35	.30	.40	.40	.65	.75	1.00
Hay, timothy	Ton	9.00	11.00	10.00		7.00	9.00	8.00	9.00	8.00	8.50
Pork, mess	Barrel	12.80		11.65		9.75		11.00		10.25	
Beef, extra mess	do	6.75				6.50		6.50		6.25	
Butter, creamery	Pound	.22	.27	.15	.16	.21	.23	.14	.14½	.23	.25
Cheese, Wisconsin	do	.09½	.12	.07½	.08	.09½	.11	.07	.08	.09½	.10½
Wool, washed	do	.28	.33	.26	.28	.25	.33	.25	.31	.25	.26
St. Louis, Mo.:											
Wheat, No. 2 red, winter	Bushel	.95¼	.95½	.84½		.78		.85½		.92¼	.93½
Corn, No. 2	do	.30	.30⅛	.31		.25½		.33½		.47	.48
Oats, No. 2	do	.24½		.22¼		.19½		.28¼		.42½	
Rye, No. 2	do	.47½	.48¼	.40		.42		.45		.64¼	.63
Potatoes, choice	do	.40	.42	.32		.40	.45	.80	.90	.95	1.10
Hay, timothy	Ton	13.25	16.00	12.00		12.00		14.50		12.00	13.00
Beef, family	Barrel	8.50	10.00	8.50	10.00	8.50	10.00	8.50	10.00		
Pork, mess	do	13.75	14.25	12.25		9.50		11.50		10.37½	10.50
Lard, prime steam	Pound	.07¼		.06½		.05 55/100		.05½		.05¼	.05⅜
Eggs	Dozen			.10		.14		.08		.18½	
Tobacco, Missouri burley	100 lbs	4.00	7.00	5.00	6.50	5.00	6.00	4.00	6.50	5.00	6.50
Wool, tub-washed, fair	do	.35	.36	.34	.35	.32	.33	.32	.33	.30	.32
San Francisco, Cal.:											
Wheat, No. 1 white	Cental	1.42½		1.30		1.26½		1.31½		1.35	
Barley, No. 2 brewing	do	.88½				.92½				1.52½	1.55
Oats, No. 2	do	1.06		.99½		1.17½	1.20	1.53½	1.55	1.32½	1.35
Corn, No. 1 white	do	1.07½		1.12½		1.05		1.00	1.05	1.32½	1.35
Rye, No. 1	do	1.85		1.05		1.00		.92½		1.32½	1.35
Potatoes	do	.45		.75		1.55	1.60	1.25		.90	1.15
Hay, No. 1 oats	Ton	12.50		10.00		9.00	11.00	9.00	12.00	13.00	14.50
Butter, good to choice	Pound	.27½		.15	.17	.17	.20	.13½	.14½	.32½	.36
Cheese	do	.10	.14	.06	.07	.08	.12½	.06	.08	.11	.13
Eggs, choice	Dozen			.30		.35	.42½	.20	.22½	.30	.32½
Wool, Oregon Valley	Pound	.20	.22½	.21½	.24	.19	.20	.18	.21	.20	.22

An examination of this table shows extraordinary advance in price, especially in corn and oats, since January of last year. In corn the increase amounts to about 66 per cent in Chicago, 70 in Milwaukee and Cincinnati, 88 in St. Louis, and 62 in New York. No. 2 in Chicago advanced from 29¼ and 29½ to 48¾ and 49½; and in New York from 40¼ and 40⅜ to 61¾. The Chicago price of oats more than doubled, advancing from 20½ to 42½. There was much less difference in the rates for wheat, the advance being from 78 to 89 in Chicago, and from 78 to 93 in St. Louis. These prices are proving an effective antidote for depression.

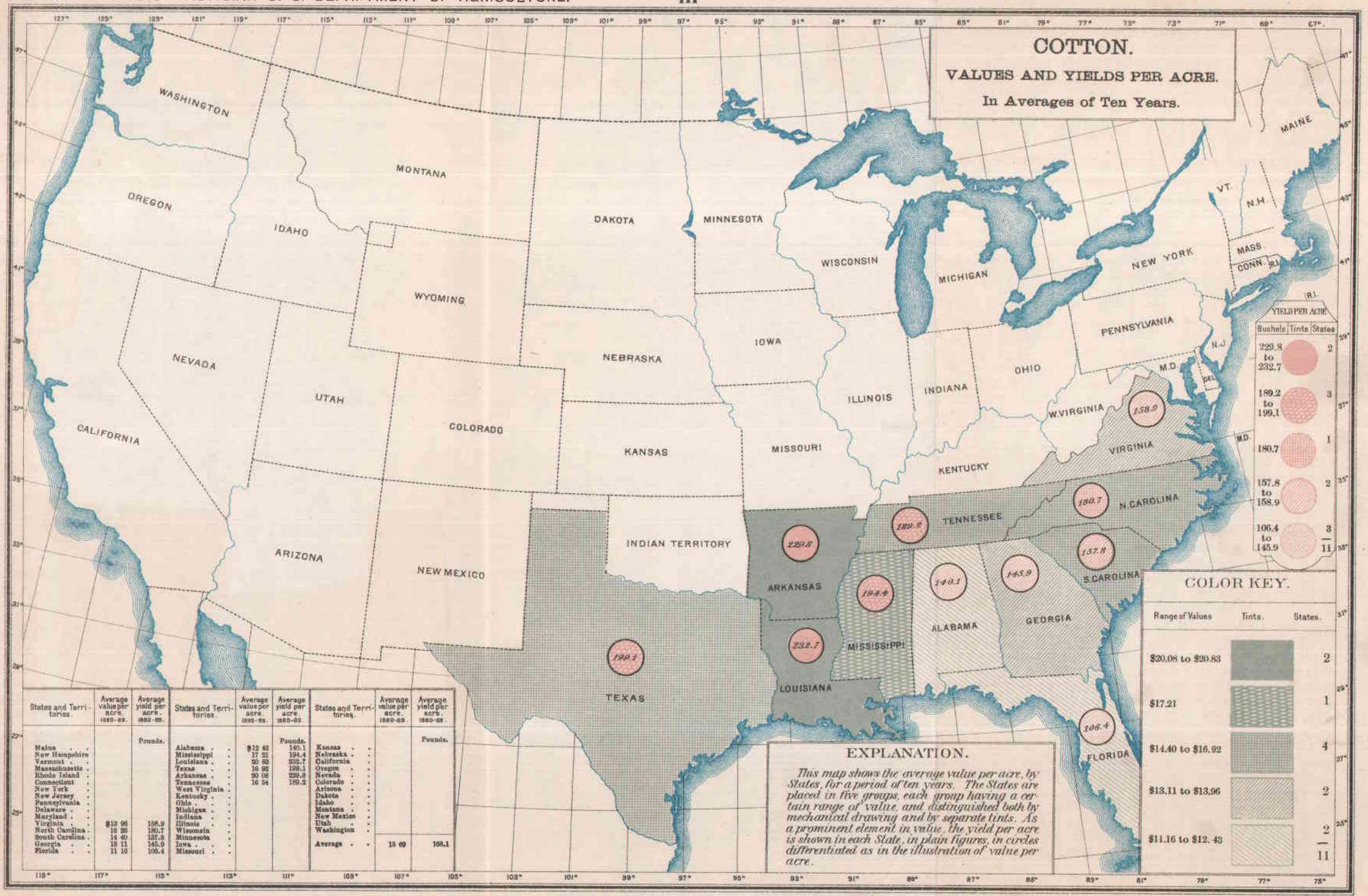
COTTON PRODUCTION AND TRADE OF THE WORLD.

The cotton plant can be grown in various sections of the world lying within the parallels of 35° of latitude north and south, and in this belt is contained the largest portion of the land surface of the globe. It is cultivated to a greater or less extent by almost every people inhabiting this portion of the earth's surface, though the districts between 20° and 35° north latitude seem now best adapted to its profitable culture. Within these lines lie the cotton districts of the United States, Northern Mexico, Egypt, Northern Africa, and of Asia, except the extreme southern portions of India and the Malay peninsula. South of the equator it is grown in Brazil, where practically almost the whole Empire may be said to be suitable for its culture; in Australia, though its cultivation has never been successfully carried on to any extent, and in Africa, where the extent of its growth and its consumption as yet are mere matters for conjecture and speculation. In fact, the area on which cotton of some kind may be produced is practically limited only by the requirements for the product. It is the fiber which is adapted for use under the widest conditions of climate and civilization, and it is the only one yet known which is and can be produced in such quantities and so cheaply that the permanent demand can not possibly exceed the supply.

PRODUCTION OF THE WORLD.

It is less than seventy years since the first attempt was made to keep an accurate record of the annual production of cotton in this country, and accurate statistics for other civilized countries where the staple is grown, are only available for a much more recent period. A large proportion of the fiber entering into civilized commerce, and not grown in the United States, is produced in countries of semicivilization, and of this product there is no accurate record. Its aggregate can only be approximated from the amount entering the channels of trade, supplemented by the probable requirements for domestic consumption. To render still more complicated the task of compiling a statement of the world's aggregate production there are countries and districts where it is largely grown and for which absolutely no data are available. The extent of its cultivation in China is a close secret, though the suitability of its soil and the character of the clothing of the population of the Empire make it certain that the production of the country is very considerable. Even in India, outside of the British districts, statements of production are only approximations based largely upon the amount coming into sight and the known requirements of the natives for dress.

The interior of Africa is a vast unknown continent, but the extent of territory capable of growing cotton must be very great. The population of this dark quarter of the globe is a matter of the merest



States and Territories.	Average value per acre. 1880-89.	Average yield per acre. 1880-89.
		Pounds.
Maine		
New Hampshire		
Vermont		
Massachusetts		
Rhode Island		
Connecticut		
New York		
New Jersey		
Pennsylvania		
Delaware		
Maryland		
Virginia	$12 96	158.9
North Carolina	16 26	180.7
South Carolina	14 40	137.8
Georgia	13 11	145.9
Florida	11 16	106.4

States and Territories.	Average value per acre. 1880-89.	Average yield per acre. 1880-89.
		Pounds.
Alabama	$12 43	140.1
Mississippi	17 51	194.4
Louisiana	20 63	232.7
Texas	16 92	199.1
Arkansas	20 08	229.8
Tennessee	16 54	189.2
West Virginia		
Kentucky		
Ohio		
Michigan		
Indiana		
Illinois		
Wisconsin		
Minnesota		
Iowa		
Missouri		

States and Territories.	Average value per acre. 1880-89.	Average yield per acre. 1880-89.
		Pounds.
Kansas		
Nebraska		
California		
Oregon		
Nevada		
Colorado		
Arizona		
Dakota		
Idaho		
Montana		
New Mexico		
Utah		
Washington		
Average	15 69	168.1

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conjecture, and while the decrees of fashion demand but scanty clothing, it is known that in all sections of the vast territory yet visited cotton fabrics largely compose the native clothing. It is scanty, but in the aggregate must absorb a large annual production of the fiber. The greater part of the crop of the world is grown by colored labor, and our Southern States may yet find their competitor for the world's market in their own class of labor at work under the tropical skies of its native home.

When the difficulties in the way of procuring a reliable estimate of the world's product, in this present age of progress and statistical information, are considered, it will be seen how little reliable are statements of that product fifty and one hundred years ago. The increase in production since the introduction of the saw gin has been enormous, but has been largely confined to the new world. The primitive methods of a century ago are still mainly followed in Asia and Africa, and if the aggregate product of those continents has increased at all, it has been probably only in proportion to population. It is a question whether in the aggregate the last century has not witnessed a decline, on account of the introduction into these lands of cheap manufactured goods. The competition between the new and the old systems of production, between improved implements and machinery and hand power, can have but one result, though the element of cheap labor may support the primitive methods for a time.

Among the earliest and most pretentious estimates of the world's production are those put forth in a letter from Levi Woodbury, Secretary of the Treasury, to James K. Polk, Speaker of the House of Representatives, dated February 29, 1836, and in response to a resolution of the House. The report accompanying gives evidence of a very careful and thorough study of the entire subject. The estimates are evidently based upon the most reliable data to be obtained, and are doubtless as nearly correct as any statement of the product of the world at the dates given could be made.

These estimates, in pounds, are as follows:

	1791.	1801.	1811.	1821.	1831.	1834.
United States	2,000,000	48,000,000	80,000,000	180,000,000	385,000,000	460,000,000
Brazil	22,000,000	36,000,000	35,000,000	32,000,000	38,000,000	30,000,000
West Indies	12,000,000	10,000,000	12,000,000	10,000,000	9,000,000	8,000,000
Egypt			83,333	6,000,000	18,000,000	25,000,000
Rest of Africa	46,000,000	45,000,000	44,000,000	40,000,000	36,000,000	34,000,000
India	130,000,000	160,000,000	170,000,000	175,000,000	180,000,000	185,000,000
Rest of Asia	190,000,000	160,000,000	146,000,000	135,000,000	115,0,0,000	110,000,000
Mexico and South America, except Brazil	68,000,000	56,000,000	57,000,000	44,000,000	35,000,000	35,000,000
Elsewhere		15,000,000	11,000,000	8,000,000	4,000,000	13,000,000
The world	490,000,000	520,000,000	555,083,333	630,000,000	820,000,000	900,000,000

NOTE.—The error in the footings of the first two columns is made in the original document.

The first of these estimates is for a year prior to the invention of the gin, and illustrates admirably the distribution of the industry at the close of the first period in the history of cotton growing. The year for which the estimate is made, 1791, is almost the last year in which cotton was raised and laboriously cleaned by hand labor for spinning by the primitive methods in vogue before steam power was successfully applied. At that date the United States was practically unconsidered in cotton production, its crop being only about 10 per

cent of that of Brazil, and ranking lowest of all countries in which it was grown. During the succeeding decade the invention of the gin and the revolution of methods which marked the beginning of the present era of the industry, stimulated the culture of the plant in this country, making it one of our agricultural staples. During the ten years the production of this country increased from 2,000,000 to 48,000,000 pounds, making the United States rank as fourth in the countries of production.

Between 1811 and 1821 this country attained its present position of the principal cotton-growing country of the world, and by 1834 it grew more than one half of the aggregate product of the world.

Beginning with 1827, there is a record of the commercial movement of the crop each year in the United States which practically covers the entire production. This actual record, with the estimates of Secretary Woodbury, makes it possible to present the following statement showing our production in periods ten years apart since 1791:

Year.	Pounds.	Year.	Pounds.
1791	2,000,000	1851	1,421,412,340
1801	48,000,000	1860	1,934,545,608
1811	80,000,000	1871	1,884,084,494
1821	180,000,000	1881	2,588,236,636
1831	444,364,650	1889	3,622,827,694
1841	759,903,750		

In preparing a statement of the aggregate production of the world at the present time, except in the case of the United States, only limited data are obtainable showing the actual product of any country, the estimates being necessarily based upon the known facts of exportation, population, and assumed consumption per head of each. Mr. Thomas Ellison, of Liverpool, after a most careful and painstaking investigation, makes a statement of the world's production at about the date of 1884, which as a whole can hardly be improved upon at present.

This statement is as follows, in bales of 400 pounds:

Country.	Bales.	Per cent.
United States of America	7,035,000	55.95
South America, West Indies, etc	300,000	2.38
East Indies	2,450,000	19.48
China	1,425,000	11.33
Japan	133,000	1.05
Turkey and Persia	120,000	0.95
Asiatic Russia	100,000	0.80
Egypt	625,000	4.97
Africa (except Egypt)	375,000	2.99
Italy and Greece	10,000	0.08
Australia, Fiji, etc	2,000	0.02
Total for the world	12,574,000	100.00

Since the date of this estimate the crop of the United States has materially enlarged, and instead of 2,814,000,000 pounds, as credited above, our production for 1889 amounted to 3,622,827,694 pounds.

The United States now consumes in its cotton manufactures between 30 and 33⅓ per cent of its annual production of the fiber, and the proportion is slowly but steadily increasing. Prior to 1840 more than three fourths of our production was consumed in foreign mills,

but our manufacturing interests have increased by a little more rapid ratio than our production. The following table presents in condensed form the average annual production and exportation, by decades, from 1841 to 1889:

Period.	Production.	Exportation.	Per cent exported.
	Pounds.	*Pounds.*	
1841–'50	1,013,706,315	739,182,698	72.9
1851–'60	1,656,207,661	1,118,106,790	67.5
1865–'70	1,297,745,903	860,437,420	66.3
1871–'80	2,183,174,113	1,493,829,284	68.4
1881–'89	3,144,427,868	2,125,612,794	67.6

With the exception of the period from 1871 to 1880 the proportion exported during each succeeding decade has declined. This break in the decline is due to the fact that production under the stimulus of free labor temporarily outran the increased capacity of our mills, but during the nine years since the demand has again adjusted itself to the enlarged supply, and the proportion of the crop seeking foreign markets again continues to grow smaller.

An interesting comparison of the average consumption of domestic mills in each section of the country since the war, in periods of six years, is presented. The figures represent actual consumption in bales of 400 pounds each:

Periods.	North.	South.	Total.
	Bales.	*Bales.*	*Bales.*
1866–'67 to 1871–'72	939,000	94,000	1,033,000
1872–'73 to 1877–'78	1,324,000	157,000	1,481,000
1878–'79 to 1883–'84	1,845,000	272,000	2,117,000
1884–'85 to 1889–'90	1,955,333	470,667	2,426,000

The figures of the last period are eloquent of the progress of the "New South." That section shows an increased mill consumption of more than 77 per cent over the preceding period, while the mills of the North during the same period increased their capacity only 6 per cent.

TRADE OF THE WORLD.

Cotton manufacture is carried on, to some extent, at least, in every country where the fiber is grown, though outside of Europe and the United States it is generally crude and by the most primitive methods. These countries weave the greater part of the cloth consumed in the world, and the fiber, in its raw and manufactured state, forms one of the most important items of their commerce.

The United Kingdom, by reason of its peculiar position and advantages, with its commercial supremacy, is the leading manufacturing nation. Her limited area, teeming population, and insular location make her naturally a manufacturing country, and this branch of industry was early developed and its improvements jealously guarded. Until within a year or two that country consumed more raw cotton in its domestic manufactures than the whole continent of Europe, but the continental countries are rapidly increasing the capacity of their mills and now demand the larger supply. The an-

nual average trade of Europe in raw cotton for a period of ten years is thus presented:

Countries.	Period.	Imports.	Exports.	Net imports.
		Pounds.	*Pounds.*	*Pounds.*
Austria-Hungary	1877-'86	176,435,968	18,200,592	158,175,376
Belgium	1877-'86	48,522,985	.....	48,522,985
Denmark	1877-'86	961,640	911,033	50,607
France	1877-'86	300,153,424	80,645,370	219,508,054
Germany	1877-'86	370,518,480	59,776,384	310,742,096
Great Britain and Ireland	1877-'86	1,588,122,771	210,522,962	1,377,599,809
Italy	1877-'86	116,150,674	32,129,620	84,021,054
Netherlands	1877-'86	89,968,976	64,393,059	25,575,917
Norway	1877-'86	4,849,459	.....	4,849,459
Portugal	1877-'86	7,690,968	.....	7,690,968
Russia in Europe	1877-'86	229,451,573	.....	229,451,573
Spain	1877-'86	97,988,297	.....	97,988,297
Sweden	1877-'85	21,239,973	.....	21,239,973
Switzerland	1877-'86	50,373,236	.....	50,373,236
Total	.....	3,102,428,424	466,639,020	2,635,789,404

The receipts of Great Britain and Ireland were more than those of all other countries. Germany, Russia, France, and Spain follow in order. This country is only exceeded in cotton manufacture by the United Kingdom, and should, ere many decades pass, attain the first rank.

According to the reliable records of Ellison & Co., of Liverpool, the United Kingdom now consumes about 37 per cent of the cotton of the world which enters the channels of civilized commerce, the rest of Europe 38 per cent, and the United States 25 per cent. Some fifty years ago, or during the period from 1841 to 1845, the average proportions were materially different. Then the United Kingdom used 55 per cent of the supply, the continent 30 per cent, and the United States only 15 per cent. This cotton is supplied by America, Brazil, East and West Indies, Egypt, etc., this country now furnishing 77 per cent. of the whole against 86 per cent fifty years ago. The cause of this slight decline in the proportion has been the heavy increase in the shipments from India, a trade stimulated to the greatest possible extent by English interests.

The following tables present in very condensed form the average annual consumption and supply in different five-year periods since 1841:

CONSUMPTION.

Periods.	Great Britain.	Continent.	United States.
	Pounds.	*Pounds.*	*Pounds.*
1841-'45	521,300,000	267,200,000	152,500,000
1851-'55	750,100,000	451,400,000	281,400,000
1861-'65	628,600,000	455,400,000	181,200,000
1871-'75	1,228,600,000	856,600,000	524,700,000
1881-'85	1,441,100,000	1,314,900,000	856,700,000
1886-'89	1,508,700,000	1,510,100,000	994,400,000

SUPPLY.

Periods.	America.	Brazil.	West Indies.	East Indies.	Egypt, etc.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
1841-'45	816,300,000	18,900,000	9,400,000	72,600,000	23,000,000
1851-'55	1,254,700,000	27,100,000	6,300,000	134,800,000	60,000,000
1861-'65	531,700,000	36,200,000	14,600,000	491,300,000	191,400,000
1871-'75	1,682,300,000	108,300,000	42,300,000	538,500,000	238,000,000
1881-'85	2,717,200,000	54,100,000	11,600,000	540,300,000	292,500,000
1886-'89	3,095,400,000	55,500,000	13,300,000	552,400,000	296,600,000

The export trade of countries which lack even and systematic development of all resources and industries is largely made up of raw agricultural products. The foreign trade of the United States is made up to the extent of some 73 per cent of farm products, and raw cotton constitutes about one third of the aggregate value, but the proportion of cotton and of all agricultural products is declining. As our population becomes denser, and our industries more diversified, we shall send abroad a smaller proportion of fiber and more manufactured goods, retaining for our own people both the profit in growing and spinning. At present, with the steady development of our manufactures which has taken place, we purchase cotton goods abroad, buying in 1890 nearly $30,000,000 worth, while we exported only $10,000,000.

This country possesses natural advantages which should make it the leading cotton-manufacturing as it is cotton-growing country of the world. The raw product produced at home in unlimited quantities is available without the expense of long distance transportation, while the inventive and progressive genius of our people insure the best machinery and methods. Our planters will continue to supply the demand from the Old World, but it will be a secondary object, the demand for domestic consumption being the first and more profitable. Cotton goods of American manufacture should be found in every market of the world, and especially should we monopolize this trade in our sister Republics of North and South America.

STATISTICAL GRAPHICS.

An Album of Agricultural Statistics has been issued during the past year to farmers' iustitutes, agricultural colleges, libraries, schools, boards of agriculture, and other organizations or individuals. The edition was limited to 10,000, and was therefore distributed with reference to use and practical utility. It is now nearly exhausted.

It consisted of sixteen maps of the United States, each representing a distinct topic, as follows:

I. Percentage of unoccupied and of farm lands, comprising the superficial area of each State.
II. Percentage of each grand division of farm area in each State.
III. Acreage in corn, per 1,000 acres of superficial area, in each State.
IV. Acreage in wheat, per 1,000 acres of superficial area, in each State.
V. Acreage in oats, per 1,000 acres of superficial area, in each State.
VI. Yield of corn per acre in each State.
VII. Yield of wheat per acre in each State.
VIII. Yield of oats per acre in each State.
IX. Average value of horses in each State.
X. Average value of cattle (exclusive of milch cows) in each State.
XI. Average value of milch cows in each State.
XII. Average value of sheep in each State.
XIII. Average value of swine in each State.
XIV. Rural population of the United States as a percentage of the total population by States.
XV. Average value of lands in the United States.
XVI. Farm tenures in the United States.

These maps are mainly based on results of past investigation conducted by the Statistician. The "distribution of cereals" is confined to the leading crops, which include all but 3 per cent of cereal

production. The rate of yield of corn, wheat, and oats, based on an average of ten crops, is also illustrated in three of this series, showing more effectively than by any other method the results of climatic adaptation, differing soils, and methods of culture. Another series of subjects treated is that of the average values of farm stock in different sections of the country, suggestive of differences in breed, degree of improvement, and effect of distance from market.

The following table presents the distribution of corn, wheat, and oats, by States, on the basis of the crops of 1888, showing the number of acres of each for every thousand acres of land surface of each State:

States.	Acres to each 1,000.			States.	Acres to each 1,000.		
	Corn.	Wheat.	Oats.		Corn.	Wheat.	Oats.
Alabama	75	13	13	Montana	.....	1	1
Arizona	.....	1	.....	Nebraska	84	32	21
Arkansas	63	7	8	Nevada	.....	1	1
California	2	24	1	New Hampshire	6	2	6
Colorado	1	2	1	New Jersey	73	30	29
Connecticut	18	1	13	New Mexico	1	1	1
Dakota	8	41	13	New York	23	22	46
Delaware	176	76	17	North Carolina	88	28	21
Florida	13	.....	2	Ohio	110	102	41
Georgia	77	10	16	Oregon	1	15	3
Idaho	.....	1	1	Pennsylvania	49	48	46
Illinois	217	68	107	Rhode Island	18	.....	9
Indiana	157	121	47	South Carolina	82	10	21
Iowa	219	70	72	Tennessee	136	45	25
Kansas	113	20	32	Texas	29	3	4
Kentucky	123	40	19	Utah	1	2	1
Louisiana	35	.....	1	Vermont	11	4	19
Maine	2	2	5	Virginia	83	24	26
Maryland	117	88	19	Washington	1	11	2
Massachusetts	12	.....	5	West Virginia	43	19	9
Michigan	26	45	22	Wisconsin	31	35	43
Minnesota	14	61	30	Wyoming	.....	.....	1
Mississippi	65	3	12				
Missouri	149	35	31	Average	41	20	15

Another series of five maps illustrates the value of farm animals, horses, milch cows, other cattle, sheep, and swine. The averages are not those of a single year, but of the current estimates of ten consecutive years, eliminating the irregularities of annual fluctuation, and representing more fairly the local differences in values. The apparently extraordinary range of prices will attract attention, but will not excite a suspicion of inaccuracy in the minds of those acquainted with the facts. The largest factor in difference in value is breed; care and feed are also important causes of difference in price, and the distance from market is another consideration affecting value.

The first group in value of horses covers a small territory—the four States, New Jersey, Rhode Island, Massachusetts, and Delaware—and presents a range of prices from $96.21 to $87.06. The second group has a range from $85.96 to $75.22, comprising eleven political divisions, including New York and Pennsylvania in the Middle States, South Carolina and Georgia in the cotton States, and Minnesota and Dakota in the Northwest. The first named are in a populous section, demanding fine stock; the next mentioned are amply able to produce a surplus, while depending on Tennessee and Kentucky and other States for a large proportion of their domestic deficiency; and the

last are in an agricultural region of so rapid settlement as to render present importation an urgent necessity. The lower groups are found in agricultural districts where horses are raised for market as well as for use on the farm. In these, the culling process, for supplying the requirements of the principal markets, is continually reducing the value of the remainder, the young and less desirable of the mature stock. In Texas the lowest average appears because of the large number raised and the proportion of small animals of "Spanish" or Mexican origin. There are herds of horses in the Territories with a large infusion of good blood, which command somewhat higher prices.

The extremes are great in values of cattle. The lowest group represents Texan cattle, which came from Mexico originally, and from Spain more remotely—the long-horn tribes, hardy from survival of the strongest, and unimproved through generations of neglect. Until within fifteen years they were the export cattle of the United States, going to Cuba and adjacent islands. They go there still, and five nearly represent the value of one fat short-horn sent to England. In the more distant Western States, the grazing region, the average value is lower than in the States farther east which buy two-year-olds to feed and finish for the market. There are various considerations of breed, feed, and distance from market which cause differences in average values.

The value of milch cows is indicated on a separate map. Of course the groups above the average represent the dairy districts. In some of the Territories, however, values are high because of scarcity and demand for milk and butter in mining camps, as the females of large grazing herds are not reckoned as milch cows.

The value of sheep ranges from $3.70 to $1.34, depending on breed and grade, quality and quantity of wool, value for meat production, and distance from market. Every district has its peculiarities in sheep husbandry, including pedigree-stock growing, mutton producing, raising early lambs, and exclusive wool growing. Three fourths of all are Merino breeds and their grades; the English breeds are numerous in some sections; and grade Mexicans are common in the Southwest.

The value of swine has an extreme range, according to average age of slaughtering, which affects the average of weight, as do also the amount and kind of feed and length of feeding season. Where swine are kept for home use mainly, and the market for a possible surplus is precarious, average prices are very low, and the stock is usually slaughtered at an early age, as pigs of small average weight. In the pork-packing regions, on the contrary, feeding is liberal and weights are heavy, while the demand is sure and the prices generally remunerative.

The following table gives the average value per head, by States, for a period of ten years:

States.	Value per head.					States.	Value per head.				
	Horses.	Cows.	Other cattle.	Sheep.	Swine.		Horses.	Cows.	Other cattle.	Sheep.	Swine.
Alabama	$67.85	$15.14	$9.67	$1.48	$3.29	Montana	$54.89	$35.65	$23.55	$2.38	$7.98
Arizona	52.82	30.12	19.31	1.84	5.70	Nebraska	72.92	28.51	24.20	2.24	5.96
Arkansas	54.09	17.29	11.29	1.55	3.00	Nevada	55.75	37.21	22.46	1.87	6.69
California	56.14	32.49	22.90	1.77	5.15	N. Hampshire	72.41	29.45	30.46	2.81	10.81
Colorado	59.57	39.12	24.36	1.94	8.06	New Jersey	96.21	36.39	32.57	4.00	9.67
Connecticut	81.23	32.26	31.83	3.47	9.98	New Mexico	38.08	27.61	17.78	1.52	7.26
Dakota	76.49	27.77	23.64	2.52	5.84	New York	85.96	30.97	31.48	3.49	8.32
Delaware	87.06	29.87	26.87	3.28	7.12	North Carolina	69.98	16.20	10.03	1.34	3.58
Florida	75.22	13.47	8.27	1.80	2.40	Ohio	71.52	30.77	26.66	2.73	5.79
Georgia	75.98	16.53	9.92	1.49	3.32	Oregon	54.54	25.13	21.63	1.65	3.63
Idaho	54.74	34.50	22.58	2.25	7.43	Pennsylvania	84.41	29.90	27.23	3.12	8.16
Illinois	67.11	30.03	24.78	2.56	5.85	Rhode Island	94.30	33.70	32.82	3.70	10.50
Indiana	67.12	28.67	23.28	2.50	5.57	South Carolina	85.34	17.90	10.93	1.71	3.74
Iowa	68.07	27.33	22.81	2.55	6.02	Tennessee	60.43	20.04	13.48	1.64	3.74
Kansas	63.82	27.36	22.94	2.04	5.98	Texas	32.17	18.36	12.20	1.97	3.16
Kentucky	61.26	27.35	22.56	2.52	4.10	Utah	44.38	30.37	20.67	2.09	8.66
Louisiana	55.86	17.97	11.50	1.67	3.63	Vermont	72.95	27.25	26.97	3.46	8.67
Maine	76.39	28.29	27.22	2.88	9.08	Virginia	66.04	21.15	18.08	2.46	4.11
Maryland	77.03	29.97	23.65	3.28	6.35	Washington	64.65	33.31	24.90	2.22	5.63
Massachusetts	93.06	34.95	34.76	3.29	12.41	West Virginia	59.97	25.86	21.10	2.32	4.22
Michigan	80.99	30.80	25.76	2.75	6.20	Wisconsin	72.18	26.65	22.64	2.28	6.19
Minnesota	75.82	25.95	21.96	2.42	5.56	Wyoming	47.49	33.50	23.46	2.23	6.86
Mississippi	69.33	15.40	9.66	1.53	3.18						
Missouri	53.56	23.08	19.32	1.85	3.99	Average	66.11	26.53	19.87	2.21	4.97

ALBUM OF AGRICULTURAL GRAPHICS.

Another publication is in preparation and nearly ready for distribution, entitled *Album of Agricultural Graphics*. This is limited to the illustration of the values per acre of the ten crops which have been for years reported in the statistical investigation of the Department, as to area grown, yield, and value. These are the only crops for which there are data extant for a similar showing of yield per acre, and the information is therefore as complete and accurate as it can be made.

The graphic method adopted includes the main feature of the illustrations of distribution of crops and prices of farm animals in the Album of Agricultural Statistics. The differences in yield per acre by States are best shown by this method. They are indicated both by color and form, in five groups, distinguished by separate tints or degrees of density in color, and also by distinguishing differences in mechanical drawing. As there are two elements in value per acre, viz., the yield per acre and the value per unit of measurement, it was deemed very desirable to show the differences in yield, which is done in a manner that does not confuse in the least the two ideas, one of which is an important factor in producing the main result, viz., the value per acre. The average yield of each State is shown in plain figures in a circle of color different from the ground tint.

The average value per acre for these ten crops, each of which is represented by a separate map, is as follows:

States and Territories.	Average value per acre.									
	Corn.	Wheat.	Oats.	Rye.	Barley.	Buckwheat.	Potatoes.	Tobacco.	Cotton.	Hay.
Maine	$24.25	$17.42	$12.42	$12.26	$16.02	$10.14	$51.48	.....	.....	$11.31
New Hampshire	24.32	18.24	14.68	9.98	16.34	10.90	46.64	.....	.....	11.08
Vermont	23.18	19.75	13.87	11.85	18.05	10.88	47.06	.....	.....	11.08
Massachusetts	22.94	20.74	14.44	12.46	18.77	10.01	61.97	$204.28	.....	18.82
Rhode Island	22.98	.....	13.52	10.49	19.13	8.25	62.55	.....	.....	16.19
Connecticut	20.94	19.14	12.82	10.89	16.43	8.49	58.60	196.58	.....	15.91
New York	18.39	15.03	11.12	8.51	16.91	8.22	37.79	159.56	.....	13.67
New Jersey	17.83	13.58	10.57	7.75	13.56	8.84	47.26	.....	.....	16.79
Pennsylvania	17.16	12.66	10.51	7.34	14.74	8.47	37.59	143.22	.....	14.00
Delaware	9.05	11.67	7.82	5.50	.....	9.45	37.77	.....	.....	14.60
Maryland	11.88	12.09	7.29	7.13	20.47	8.84	37.68	44.24	.....	14.47
Virginia	8.46	8.05	4.73	4.71	12.01	7.04	34.29	44.85	$13.96	13.64
North Carolina	7.15	6.42	4.56	4.82	9.65	6.10	38.33	51.21	16.26	13.45
South Carolina	6.19	6.73	6.18	5.09	14.88	.....	46.11	.....	14.40	15.71
Georgia	6.81	7.01	5.85	6.07	13.57	.....	53.10	.....	13.11	17.31
Florida	7.22	.....	7.04	.....	.....	.....	65.65	.....	11.16	16.37
Alabama	7.69	6.60	6.36	6.28	11.38	.....	56.02	.....	12.43	16.54
Mississippi	8.47	6.35	6.40	7.29	.....	.....	53.01	.....	17.21	16.16
Louisiana	9.54	.....	7.07	11.19	.....	.....	54.03	.....	20.83	14.50
Texas	9.52	9.25	9.98	8.51	10.79	.....	58.21	.....	16.92	12.20
Arkansas	10.07	7.23	7.68	6.57	.....	.....	47.14	50.22	20.08	13.90
Tennessee	8.92	5.95	5.20	4.67	9.27	5.66	30.49	48.30	16.54	14.14
West Virginia	11.80	9.63	6.47	6.09	12.98	6.66	34.90	56.29	.....	10.41
Kentucky	9.97	8.23	6.36	6.23	14.15	6.88	30.90	58.63	.....	12.70
Ohio	13.16	12.42	9.73	7.61	15.00	8.24	33.54	66.28	.....	12.71
Michigan	13.16	13.40	10.44	7.69	15.96	8.75	32.02	64.24	.....	13.22
Indiana	10.84	11.36	7.88	6.97	14.96	7.72	31.00	49.43	.....	11.35
Illinois	9.38	11.32	8.95	8.86	12.88	7.65	35.24	48.18	.....	10.26
Wisconsin	11.04	10.03	8.68	7.86	12.67	6.75	35.96	101.45	.....	9.21
Minnesota	10.86	9.31	8.63	7.30	10.93	6.82	35.43	.....	.....	6.76
Iowa	8.63	7.56	7.34	6.42	10.34	7.60	32.51	.....	.....	6.39
Missouri	8.94	9.23	6.96	6.66	12.04	7.81	32.37	63.27	.....	9.38
Kansas	7.90	9.41	6.64	6.12	7.90	8.72	40.07	.....	.....	5.55
Nebraska	7.58	6.87	5.78	5.51	7.59	7.25	30.68	.....	.....	4.82
California	18.99	10.35	13.74	8.34	12.77	15.69	56.61	.....	.....	16.02
Oregon	16.85	12.02	11.48	11.88	14.25	10.23	47.75	.....	.....	14.45
Nevada	17.60	15.96	18.15	.....	18.29	.....	76.25	.....	.....	12.95
Colorado	17.77	16.22	14.97	12.78	17.43	.....	53.12	.....	.....	15.76
Arizona	16.73	12.73	.....	.....	14.03	.....	50.65	.....	.....	13.71
Dakota	8.67	7.52	7.29	7.21	9.02	6.80	35.17	.....	.....	5.10
Idaho	18.28	14.17	15.09	8.41	18.06	.....	58.62	.....	.....	11.26
Montana	20.12	14.48	15.24	.....	18.03	.....	73.03	.....	.....	12.58
New Mexico	15.04	12.93	10.78	.....	14.98	.....	61.27	.....	.....	13.52
Utah	13.54	12.71	11.29	6.85	12.60	.....	37.89	.....	.....	8.35
Washington	17.50	12.16	15.08	11.17	16.54	.....	54.91	.....	.....	13.10
Wyoming	.....	14.87	13.78	.....	.....	.....	58.91	.....	.....	11.41
Average	9.47	9.95	8.16	8.27	12.76	8.24	38.34	61.51	15.69	11.08

The highest value per acre of corn is $24.32, in New Hampshire, and the lowest $6.19, in South Carolina. In the great corn belt the average in Illinois was $9.38 and in Iowa $8.63. In the Missouri Valley the average is low by reason of great abundance and cost of transportation to market; in the South, because of lower rate of yield, while prices are medium or high. Though corn grows everywhere except at the higher elevations, with a wide range of local variation in different climates and soils, its largest rate of production is in the lower levels of the valleys of the Ohio and the Missouri. It is evident that climate as well as soil is a factor in this superior rate of yield.

The New England States and Colorado occupy the first group in value per acre of wheat, which ranges from $16.22 to $20.74. The second, from $15.96 to $13.40, includes Nevada, New York, Wyoming, Montana, Idaho, and New Jersey. The lowest group has

a range from $6.87 to $5.95. The seaboard region has the advantage of fertilization and high prices, though the areas cultivated are small.

The range of value per acre of oats is from $18.15 in Colorado to $4.56 in North Carolina. The yield per acre is 36 bushels to 9.5 bushels. Washington, Illinois, Minnesota, Vermont, Montana, Michigan, Iowa, New Hampshire, Colorado, Idaho, Ohio, and Wisconsin comprise the first group. All but three of these are on the Northern border. Oats deteriorate rapidly in quality and weight in the lower latitudes. In the South the crop can only be grown in winter.

Rye is a crop for poor soils and is not much grown in this country. The first group has a range of value from $12.78 to $11.17, the lowest from $5.51 to $4.67. The average yield in the South is lower by reason of the fact that it is grown more for winter pasture than for seed.

Barley has a higher value per acre than any other cereal, the first group having a range of $20.47 to $17.43 per acre. The lowest has a value from $9.65 to $7.59 per acre. The highest value per acre is in Maryland, where the yield averages 25.5 bushels under fertilization and generally good cultivation. The highest average yield is 29.1 bushels, in Washington. Still a large quantity is annually imported on account of the proximity of Canada to the great beer-manufacturing centers and the high malting quality of the Canadian product.

Buckwheat is by no means a general crop, the larger portion being grown in New York and Pennsylvania. The largest average value per acre is $15.69, in California.

The average value per acre of potatoes is $38.34 and the average yield 76.2 bushels. Like oats, the potato is adapted to cool climates of the higher latitudes. The range of yield is from 117 to 55 bushels and the average value per acre from $76.25 to $30.49.

The value of tobacco per acre is relatively high, with a very wide range, from $204.28 to $44.24 per acre. The highest yields and prices per pound are for seed-leaf tobacco, used exclusively for cigars, and grown solely in the Northern States, and mainly in a few counties on the Connecticut River, three in New York, three in Pennsylvania, and in limited districts in Wisconsin and Ohio.

The farm value of cotton ran from $20.83 in Louisiana to $11.16 in Florida. The yield per acre is highest in Louisiana, averaging 232.7 pounds of lint, and lowest in Florida, averaging 106.4 pounds, a part of which is sea-island cotton, which has a high relative value. Arkansas, Mississippi, Tennessee, and Texas follow Louisiana in the order of value, while the order in yield is Louisiana, Arkansas, Texas, Mississippi, and Tennessee.

The yield per acre is an important element in value per acre, but not the only one. The price per pound or bushel also differs, owing to distance from market and local scarcity or abundance. The tendency of railroad extension is toward equalization of prices, yet the difference in State averages of price shows how great differentiation in price still exists. It naturally happens that where prices are low yields are also low from lack of inducement to high culture, intensifying the disparity in values per acre. A study of these differences may surprise the casual reader and may prove fruitful of practical suggestions if made with care and thoughtfulness.

The average yield per acre of each State for ten years has been as follows:

States and Territories.	Average yield per acre.									
	Corn.	Wheat.	Oats.	Rye.	Barley.	Buckwheat.	Potatoes.	Tobacco.	Cotton.	Hay.
	Bush.	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Lbs.*	*Lbs.*	*Tons.*
Maine	32.2	13.6	28.3	13.0	21.6	18.1	94.5	.....	.....	.97
New Hampshire	32.7	14.4	32.3	11.0	21.8	17.4	89.3	.....	.....	.93
Vermont	32.5	16.9	33.1	14.5	24.7	18.2	97.7	.....	.....	1.05
Massachusetts	31.6	16.3	29.9	14.3	23.2	14.2	95.5	1485.4	.....	1.09
Rhode Island	30.2	.....	27.9	12.1	23.9	10.4	91.8	.....	.....	.96
Connecticut	30.1	16.6	28.1	13.5	21.5	12.1	80.6	1417.1	.....	.99
New York	29.8	14.7	28.5	11.9	22.7	13.4	78.0	1339.6	.....	1.11
New Jersey	30.5	12.9	26.7	10.8	17.0	11.9	77.6	.....	.....	1.09
Pennsylvania	31.0	12.6	28.0	10.6	20.1	13.0	73.0	1205.3	.....	1.14
Delaware	19.2	11.6	21.1	8.3	.....	14.3	66.3	.....	.....	1.04
Maryland	24.1	12.2	20.1	10.3	25.5	13.0	67.8	662.7	.....	1.07
Virginia	16.8	8.2	11.9	6.9	16.1	10.8	60.7	596.1	158.9	1.10
North Carolina	12.2	6.0	9.5	5.8	11.0	9.7	60.7	480.8	180.7	1.16
South Carolina	9.4	5.7	10.3	4.6	14.2	.....	55.0	.....	157.8	1.15
Georgia	10.5	6.0	9.8	5.5	14.0	.....	58.8	.....	145.9	1.23
Florida	9.7	.....	10.2	.....	.....	.....	68.3	.....	106.4	.98
Alabama	12.7	6.0	10.8	5.5	10.4	.....	62.1	.....	140.1	1.21
Mississippi	14.3	5.7	11.0	6.5	.....	.....	62.3	.....	194.4	1.28
Louisiana	16.0	.....	12.5	8.3	.....	.....	62.8	.....	232.7	1.22
Texas	18.0	10.0	23.4	9.7	15.9	.....	62.5	.....	199.1	1.26
Arkansas	19.7	7.5	16.9	7.4	.....	.....	68.5	578.0	229.8	1.23
Tennessee	20.6	6.7	13.7	6.2	13.4	8.5	59.2	645.4	189.2	1.21
West Virginia	23.4	10.2	17.7	8.5	19.3	10.0	65.7	609.5	.....	1.01
Kentucky	23.8	9.4	18.2	9.0	21.0	9.5	61.3	755.2	.....	1.16
Ohio	30.9	13.6	30.9	12.0	20.6	11.0	68.7	912.8	.....	1.21
Michigan	28.9	15.2	32.3	12.0	23.1	13.3	76.7	503.6	.....	1.23
Indiana	28.9	13.1	27.5	11.4	21.8	10.4	66.0	721.7	.....	1.27
Illinois	26.7	13.4	34.2	15.5	21.0	10.3	71.9	651.9	.....	1.29
Wisconsin	27.2	12.0	30.4	13.4	22.7	10.3	81.9	967.2	.....	1.17
Minnesota	29.6	12.5	33.1	14.5	23.1	10.5	92.3	.....	.....	1.32
Iowa	30.9	10.6	32.3	12.9	21.8	10.9	79.3	.....	.....	1.22
Missouri	27.4	11.7	26.0	11.8	20.3	11.4	70.3	802.4	.....	1.20
Kansas	28.5	13.9	28.0	15.2	18.9	11.1	66.7	.....	.....	1.28
Nebraska	32.8	11.1	29.1	13.8	19.6	10.2	74.1	.....	.....	1.31
California	27.9	12.5	26.2	10.5	20.4	20.8	86.8	.....	.....	1.39
Oregon	23.8	16.3	27.9	15.9	26.0	14.2	100.0	.....	.....	1.39
Nevada	24.6	17.6	29.8	.....	22.2	.....	91.1	.....	.....	1.24
Colorado	26.7	19.5	31.2	17.1	24.5	.....	89.3	.....	.....	1.25
Arizona	20.9	13.8	.....	.....	19.2	.....	63.8	.....	.....	1.07
Dakota	25.4	11.9	27.7	14.9	21.3	11.3	85.0	.....	.....	1.30
Idaho	23.2	17.1	30.9	13.0	27.2	.....	101.3	.....	.....	1.19
Montana	26.6	17.6	32.6	.....	27.2	.....	107.4	.....	.....	1.15
New Mexico	19.9	13.6	22.7	.....	19.6	.....	78.3	.....	.....	1.08
Utah	19.7	17.2	26.6	10.8	22.6	.....	90.5	.....	.....	1.28
Washington	24.3	17.0	36.0	15.1	29.1	.....	117.1	.....	.....	1.31
Wyoming	.....	18.0	29.7	.....	.....	.....	95.5	.....	.....	1.17
Average	24.1	12.0	26.6	11.9	21.7	12.8	76.2	727.1	168.1	1.19

IMPORTS AND EXPORTS OF AGRICULTURAL PRODUCTS.

The official records of foreign trade for the fiscal year 1890 show an increase in the total exports from this country over last year of $115,011,219, changing the balance of trade, which was against us in 1889 by $14,849,043, to one in our favor of $55,983,419. The importance of the farmer in our foreign commerce is emphasized by the fact that the product of his labor last year furnished 74.2 per cent of our total shipment abroad, while 47.4 per cent of our imports were of agricultural products. During 1889 the balance in favor of our farmers in this international exchange of farm products amounted to $174,000,000, but the transactions of 1890 leave a still more gratifying balance on the credit side of the ledger amounting to $253,000,000. This at least is the apparent balance, though the real difference is much less, for the value of exports includes transportation to seaboard,

and that of imports is increased by the cost of sea and land transportation from foreign countries.

The greater part of our increase in exports was made up of the increase in agricultural products, which amounted to $97,000,000. This enlargement of the foreign market for our agricultural surplus was especially gratifying, coming at a period when our farmers were beginning to feel keenly the decline in agricultural values which was prevailing in all portions of the world. More than one half of the increased demand was for animals and their products, the sales of cattle alone amounting to $15,000,000 more than in the previous year. Beef products contributed $7,000,000 to the increase, while our pork products, though partially barred from some countries, showed a still more striking increase, amounting to $20,000,000.

The shipments of breadstuffs showed an advance in value over the previous year of $31,000,000, wheat contributing about one half. An encouraging feature of this branch of the trade was the increase of $10,000,000 in shipments of corn and $4,000,000 in oats.

The increase in agricultural imports was not in proportion to the total increase of imports, but aggregated $18,000,000. Of this increase sugar furnished $8,000,000, tea and coffee $4,000,000, and tobacco $7,000,000, while numerous other products show smaller gains. There was a marked falling off in value of hides, wool, and hemp imported. As our agriculture becomes more diversified, and our range of successful cropping more extended, the balance of foreign exchange in favor of our agriculture will become more pronounced. Sugar is now the largest item purchased abroad, and our present activity and success in the line of beet, cane, and sorghum experiments indicates a speedy curtailment of the amounts paid each year for foreign sugars.

The following tables present in itemized form our foreign trade in agricultural products for two years past:

IMPORTS.

Articles.	1889.	1890.
Sugar and molasses:		
Sugar	$88,543,971	$96,094,532
Molasses	4,753,897	5,168,795
Sugar drainings	4,026	3,999
Total sugar and molasses	93,301,894	101,267,326
Tea, coffee, and cocoa:		
Tea	12,654,640	12,317,493
Coffee	74,724,882	78,267,432
Cocoa, crude, and leaves and shells of	2,142,061	2,312,781
Unenumerated items	337,739	556,931
Total tea, coffee, and cocoa	89,859,322	93,454,637
Animals and their products, except wool:		
Cattle	703,469	244,747
Horses	4,868,862	4,840,485
Sheep	1,259,000	1,268,209
All other and fowls	392,712	413,491
Bristles	1,284,724	1,286,219
Butter	24,577	13,679
Cheese	1,135,184	1,295,506
Eggs	2,418,976	2,074,912
Glue	454,460	471,829
Grease	212,198	264,629
Hair	2,585,941	3,026,586
Hides	25,127,750	21,881,886
Hide cuttings, etc	232,251	348,440
Hoofs, horns, etc	303,575	236,648
Meats—		
Preserved	329,411	407,038
All other	199,734	196,696

IMPORTS—Continued.

Articles.	1889.	1890.
Milk, preserved or canned	$85,485	$98,395
Oil, animal	3,677	6,471
Sausage skins	377,750	494,958
Unenumerated items	263,278	490,648
Total animals and their products, except wool	42,263,014	39,361,472
Fibers:		
Animal—		
Wools	17,974,515	15,264,083
Silk, unmanufactured	19,333,229	24,331,867
Vegetable—		
Cotton	1,194,505	1,392,728
Flax	2,070,729	2,188,021
Hemp and all substitutes	9,433,774	7,341,956
Jute	2,853,664	3,249,926
Sisal grass and other vegetable substances	6,110,308	7,064,184
Fibers not elsewhere specified	483,212	697,680
Total fibers	59,453,936	61,530,445
Miscellaneous:		
Breadstuffs—		
Barley	7,723,838	5,629,849
Corn	1,216	908
Oats	10,178	8,950
Oatmeal	56,002	59,300
Rye	24	115,657
Wheat	119,017	112,308
Wheat flour	5,792	5,049
Breadstuffs and farinaceous substances not elsewhere specified	1,055,655	1,210,982
Chicory	216,573	209,283
Fruits and nuts	18,746,417	20,746,471
Hay	1,082,885	1,143,445
Hops	1,155,472	1,053,616
Indigo	2,684,105	1,827,937
Ivory, vegetable	96,574	61,477
Malt, barley	111,331	161,666
Oils, vegetable:		
Fixed or expressed—		
Olive	696,065	819,110
Other	1,108,854	1,340,551
Volatile or essential	1,183,005	1,061,631
Opium, crude	1,454,097	1,183,712
Plants, trees, and shrubs	325,331	343,226
Rice and rice meal	3,499,437	2,540,674
Seeds	5,097,223	4,089,814
Spices:		
Ground	173,668	249,077
Unground—		
Nutmegs	514,888	534,340
Pepper	1,578,421	1,619,215
All other	890,889	820,439
Tobacco, leaf	10,868,226	17,605,192
Vanilla beans	699,903	559,867
Vegetables:		
Beans and pease	766,343	1,307,702
Potatoes	321,106	1,365,898
Pickles and sauces	349,422	386,307
All other—		
In their natural state or in salt or brine	423,124	885,390
Prepared or preserved	389,804	510,077
Wines:		
Champagne and other sparkling	4,254,413	4,752,572
Still wines—		
In casks	2,126,548	2,450,174
In bottles	1,325,811	1,657,210
Unenumerated items	123,187	148,491
Total miscellaneous	71,254,894	78,577,562
RECAPITULATION.		
Sugar and molasses	93,301,894	101,267,326
Tea, coffee, and cocoa	89,859,322	93,454,637
Animals and their products, except wool	42,263,014	39,361,472
Fibers, animal and vegetable	59,453,936	61,530,445
Miscellaneous	71,254,894	78,577,562
Total agricultural imports	356,133,060	374,191,442
Total imports	745,131,652	789,310,409
Per cent of agricultural matter	47.8	47.4

EXPORTS.

Articles.	1889.		1890.	
	Quantities.	Value.	Quantities.	Value.
Animals, living:				
Cattle.....number..	205,786	$16,616,917	394,836	$31,261,131
Hogs.....do....	45,128	356,764	91,148	909,042
Horses.....do....	3,748	592,469	3,501	680,410
Mules.....do....	2,980	356,333	3,544	447,108
Sheep.....do....	128,852	366,181	67,521	243,077
All other and fowls.....	.....	86,141	.....	97,360
Animal matter:				
Bones, hoofs, horns and horn tips, strips, and waste.....	.....	242,429	.....	271,533
Casings for sausages.....	.....	510,114	.....	697,772
Eggs.....dozen..	546,750	75,936	380,884	58,675
Glue.....pounds..	534,203	72,283	728,696	88,484
Grease, grease scraps, and all soap stock.....	.....	827,876	.....	1,506,819
Hair and manufactures of.....	.....	388,731	.....	344,558
Hides and skins other than furs.....	.....	909,798	.....	1,828,635
Honey.....	.....	93,888	.....	113,101
Oils:				
Lard.....gallons..	861,303	542,897	1,214,611	663,343
Other animal.....do....	558,080	377,919	727,732	457,926
Meat products—				
Beef products—				
Beef, canned.....pounds..	51,025,254	4,375,213	82,638,507	6,787,193
Beef, fresh.....do...	137,895,391	11,481,861	173,237,596	12,862,384
Beef, salted or pickled..do....	55,006,399	3,043,324	97,508,419	5,250,068
Beef, other cured.....do....	194,036	17,819	102,110	9,223
Tallow.....do....	77,844,555	3,942,024	112,745,370	5,242,158
Mutton.....do....	296,220	25,995	256,711	21,793
Oleomargarine—				
Imitation butter.....do....	2,192,047	250,605	2,535,926	297,264
The oil.....do....	28,102,534	2,664,492	68,278,098	6,476,258
Pork products—				
Bacon.....do....	357,377,399	29,872,231	531,899,677	39,149,635
Hams.....do....	42,847,247	4,779,616	76,591,279	7,907,125
Pork, fresh.....do....	22,794	1,662	279,463	15,406
Pork, salted or cured...do....	64,110,845	4,733,415	79,788,268	4,753,488
Lard.....do....	318,242,990	27,329,173	471,093,598	33,453,520
Poultry and game.....	.....	9,827	.....	23,365
All other meat products.....	.....	876,161	.....	931,770
Dairy products—				
Butter.....pounds..	15,504,978	2,568,765	29,748,042	4,187,489
Cheese.....do....	84,999,828	7,889,671	95,376,053	8,591,042
Milk.....	.....	260,590	.....	303,325
Wax, bees'.....pounds..	99,917	23,918	171,391	19,727
Wool, raw.....do....	141,576	23,065	231,042	33,543
Total value of animals and animal matter.....	.....	126,586,103	.....	175,987,350
Bread and breadstuffs:				
Barley.....bushels..	1,440,321	853,490	1,048,311	754,605
Bread and biscuits.....pounds..	14,494,880	749,652	15,035,540	766,476
Corn.....bushels..	69,592,929	32,982,277	101,973,717	42,658,015
Cornmeal.....barrels..	312,186	870,485	361,248	896,879
Oats.....bushels..	624,226	245,562	18,692,776	4,510,055
Oatmeal.....pounds..	10,210,413	273,173	25,460,342	784,879
Rye.....bushels..	267,252	158,917	2,257,377	1,279,814
Rye flour.....barrels..	3,669	13,370	3,938	13,782
Wheat.....bushels..	46,414,129	41,652,701	54,387,767	45,275,906
Wheat flour.....barrels..	9,374,803	45,296,485	12,231,711	57,036,168
All other breadstuffs and preparations of, used as food.....	.....	780,549	.....	949,348
Total value of bread and breadstuffs.....	.....	123,876,661	.....	154,925,927
Cotton and cotton-seed oil:				
Cotton—				
Sea island.....pounds..	6,419,569	1,391,495	9,220,819	2,260,717
Other unmanufactured.....do....	2,378,397,100	236,383,775	2,462,579,094	248,688,075
Cotton-seed oil.....gallons..	2,690,700	1,298,609	13,384,385	5,291,178
Total value of cotton and cotton-seed oil.....	.....	239,073,879	.....	256,259,970

EXPORTS—Continued.

Articles.	1889.		1890.	
	Quantities.	Value.	Quantities.	Value.
Miscellaneous:				
Broom corn		$152,543		$111,147
Fruits and nuts—				
Apples, dried ..... pounds..	22,102,579	1,201,070	20,861,462	1,038,682
Apples, green or ripe ....barrels..	942,406	2,249,375	496,506	1,231,436
Fruits, preserved—				
Canned		915,341		698,321
Other		52,048		59,401
All other, green, ripe, or dried		621,390		1,003,846
Nuts		32,360		27,861
Hay .....tons..	21,928	388,777	36,274	567,558
Hops .....pounds..	12,589,262	2,823,832	7,540,854	1,110,571
Oil-cake and oil-cake meal ....do....	588,317,880	6,927,912	711,704,373	7,999,926
Oils—				
Linseed.....gallons..	72,451	42,759	89,288	55,036
Other vegetable		55,812		102,792
Rice .....pounds..	439,706	24,124	388,914	20,728
Seeds—				
Clover ..... do....	34,253,137	3,110,583	26,500,578	1,762,034
Cotton.....do....	11,373,865	119,279	7,660,601	74,575
Flaxseed or linseed .....bushels..			14,678	19,792
Timothy.....pounds..	10,200,673	451,728	11,051,053	473,770
All other		192,914		307,717
Tobacco—				
Leaf.....pounds..	211,521,051	18,546,991	244,343,740	21,149,869
Stems and trimmings .....do....	12,238,181	354,077	11,308,286	329,687
Vegetables—				
Onions .....bushels..	75,074	63,780	80,275	72,760
Pease and beans.....do....	294,456	560,574	261,212	558,317
Potatoes.....do...	471,955	316,224	406,618	269,693
Vegetables, canned		311,254		231,205
All other, including pickles		198,120		225,060
Wine—				
In bottles ....dozen..	7,311	33,000	7,231	32,350
Not in bottles.....gallons..	372,350	236,488	393,323	238,580
All other agricultural products		228,399		271,235
Total value of miscellaneous products		40,210,753		40,044,009
RECAPITULATION.				
Animals and animal matter		126,586,103		175,986,750
Bread and breadstuffs		123,876,661		154,925,927
Cotton and cotton-seed oil		239,073,879		256,259,970
Miscellaneous products		40,210,753		40,044,009
Total agricultural exports		529,747,396		627,216,656
Total exports		730,282,609		845,293,828
Per cent of agricultural matter		72.5		74.2

NOTE.—In this compilation of domestic agricultural exports sugar and molasses are not included because they are mainly reëxports of foreign production. The totals differ from those given by the Bureau of Statistics of the Treasury Department, they having included sugar and molasses, "ginseng and roots, herbs and barks not otherwise specified," and glucose, or grape sugar.

FOREIGN DISTRIBUTION OF CEREALS.

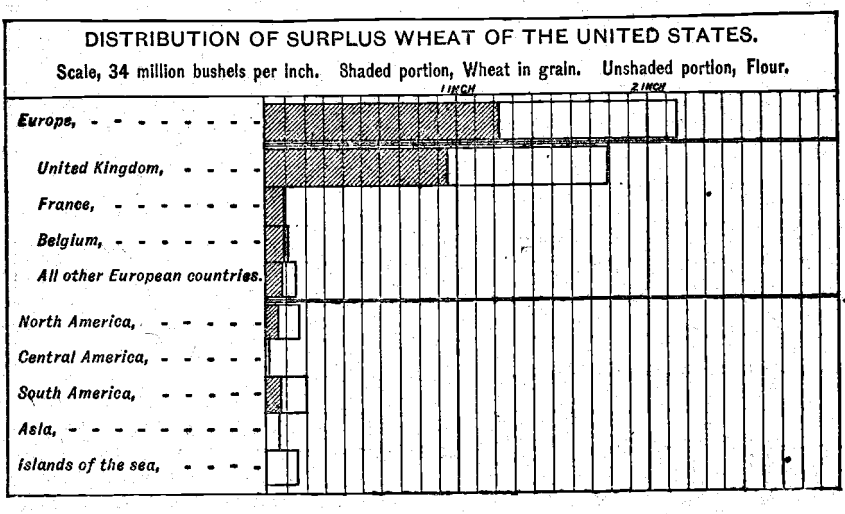
We have practically no surplus of cereals except wheat and corn. A large quantity of corn might be spared were there a foreign market for it. Wheat, in the form of grain and flour, is the principal cereal for the foreign trade. Where is it wanted? The record of the last fiscal year, 1889-'90, makes the foreign shipment of wheat unmanufactured 54,387,767 bushels, and of wheat in the form of flour 55,042,703 bushels, or a total of 109,430,470 bushels, which was 22.3 per cent of the estimated crop. Of this aggregate 78.2 per cent went direct to Europe; 5.7 per cent to Canada, most of which was ultimately added to the European supply. Central and South America took 8 per cent; the Islands of the Seas 5.6 per cent; and

the great continents of Asia, Africa, and Australasia only 2.5 per cent, or 2,725,098 bushels, which includes our wheat supplies to these continents and nearly two thirds of the population of the world. A single county of Dakota could supply from its surplus this requirement, and in any good season each of five principal counties could do it easily, viz, Brown, Cass, Grand Forks, Pembina, and Walsh, and possibly each of several others, and yet all the back counties of the two Dakotas are rushing forward in their search for more markets of more continents to conquer. It is an ambition that has already seriously reduced the price of wheat of the United States.

The details of this distribution are presented by countries, as follows:

Countries.	Grain.	Flour as wheat.	Total wheat.	Grain.	Flour.	Total.
				Per cent.	*Per cent.*	*Per cent.*
Europe	49,069,570	36,616,811	85,686,381	44.8	33.4	87.2
United Kingdom	38,240,523	33,407,946	71,648,469	34.9	30.5	65.4
France	3,846,505	1,274	3,847,779	3.5	.....	3.5
Belgium	3,741,303	765,423	4,506,726	3.4	.7	4.1
All other European countries	3,241,239	2,442,168	5,683,407	3.0	3.2	5.2
North America	2,295,043	3,916,787	6,211,830	2.1	3.6	5.7
Central America	56,215	810,410	866,625	.1	.7	.8
South America	2,687,333	5,143,838	7,831,171	2.5	4.7	7.2
Asia	23	2,492,829	2,492,852	.....	2.3	2.3
Africa	37,805	53,393	91,198	.....	.....	.....
Australasia	67,990	73,058	141,048	.1	.1	.2
Islands of the Sea	173,788	5,935,577	6,109,365	.2	5.4	5.6
Grand total	54,387,767	55,042,703	109,430,470	49.8	50.2	100

To enforce the attention of the most casual reader to the meaning of this unequal distribution and throw a strong light upon the practical worthlessness of the world's markets for wheat, unless an exception be made of Liverpool, a diagram has been prepared which requires only a glance to make the subject clear as sunlight.



The exports of corn for the year ended June 30, 1890, and the principal countries receiving it, are as follows:

Countries to which exported.	Bushels.
Great Britain	54,657,198
France	8,481,689
Germany	11,419,063
Belgium	4,800,295
Denmark	5,788,733
Netherlands	3,367,823
All other European countries	1,091,745
Total to Europe	89,606,546
All other countries	13,812,163
Total	103,418,709

It is proper to observe that this is the largest quantity of corn ever exported in a single year; nearly all as grain, or 101,973,717 bushels, the remainder being corn meal, 361,248 barrels, reduced to grain on the basis of 4 bushels per barrel. More than half of the meal went to Canada.

The reason why last year's shipments were so large is solely the fact that the export price was the lowest known since 1850. The average was 41.8 cents per bushel. The next largest exportation was in 1879–'80, 99,572,329 bushels, when the export price was very low, or 54.3 cents per bushel. As might be expected, the smallest exportation in the last forty years was 1,392,115, exclusive of meal, when the price was 93 cents. There were two or three years between 1860 and 1870 when the price was higher in currency, but not in gold. The exportation of corn depends upon its price in this country, as set by the demands of home consumption. The latest illustration of this fact is seen in the exports of December, 1890, which amounted to 1,594,588 bushels, valued at 60.3 cents per bushel, while the exports of December, 1889, were 6,421,352, valued at 43.2 cents per bushel. The proportion of last year's exportation, taken outside of Europe, was only 13.4 per cent, almost exactly the proportion of the previous year's smaller shipments. Either McLean or Livingston County, Illinois, usually produces nearly as much as all the corn taken by the markets of the world outside of Europe in the year of most extensive exportation. As this country produces three fourths of all the corn of the world, and consumes more than twice as much as all other countries combined, it will require much missionary effort and experimental teaching in the preparation of a maize dietary to induce foreigners to make use of corn for food. It is only wanted now when very cheap, as a constituent in the feed rations of horses and cattle, and only to a very limited extent, by a few buyers in Western Europe. An increase in European requirements, from consumption as food, would benefit the consumer abroad far more than the producer in this country.

SUGAR PRODUCTION IN EUROPE.

The evolution of the beet-sugar manufacture is a growth of the present century. It was fostered early in the century by science and government through invention and bounty, yet half of its development has occurred during the last decade. Profiting by Euro-

pean experience, this country has a less difficult problem to solve. There have been no satisfactory experiments in the manufacture here until the success at Alameda in California. Those of Maine, Wisconsin, and Illinois were preliminary and inconclusive. They were necessarily failures from lack of skill and completeness of preparation, and still more from failure of farmers to coöperate. In the Maine case the average contracts were for only a fraction of an acre, a garden patch receiving ordinary field cultivation, without knowledge of the necessary culture or fertilization, without the adjunct of cattle-feeding and utilization of the by-product.

Now there promises to be a revival of the experiment since the repeated successes in California, with high promise of continued enlargement. Nebraska has already entered the lists. It would be a craven and ignominious acknowledgment to admit that the manufacture can be carried on successfully throughout Europe and can not be a success upon the continent of North America, when a good yield of beets having a high content of sugar has been repeatedly grown from the Atlantic to the Pacific, and good sugar has been made year after year at a profit.

There are many intelligent citizens, even some newspaper editors, who are entirely unaware of the fact that half the commercial sugar of the world is made of beet, on a continent where cane can not be grown, and no other source of sugar is extensively available, and especially oblivious of the fact that cane sugar is practically barred entrance into Europe, because the home product of beet sugar leaves no room for it. This general proposition has been vigorously assailed in the public press, though the facts show that for several years the continent of Europe, exclusive of the British Isles, has exported more than its imports. Indeed, few except those who keep abreast of the statistical situation in sugar production are fully aware of the recent development of the industry. The past season, if Licht's estimate is reliable, the production (3,627,967 metric tons) is ample for the consumption of Great Britain and the continent together. The progress of beet-sugar manufacture in Europe in thirteen years, according to the authority quoted, is shown by the following figures of production, which are stated in metric tons of 2,204.6 pounds.

Years.	Germany.	France.	Austria-Hungary.	Russia and Poland.	Belg'um.	Holland and other countries.	Total.
1877–'78	893,828	398,182	330,792	220,000	63,075	25,000	1,429,827
1878–'79	420,686	432,694	405,906	215,000	69,957	30,000	1,574,188
1879–'80	411,625	277,912	406,375	225,000	58,017	25,000	1,403,929
1880–'81	594,223	333,614	493,032	250,000	68,636	30,000	1,774,545
1881–'82	644,775	393,269	411,015	308,779	73,136	30,000	1,860,974
1882–'83	848,124	425,194	473,000	284,391	89,703	35,000	2,146,412
1883–'84	986,402	473,676	445,952	310,000	106,586	40,000	2,362,616
1884–'85	1,155,000	308,400	557,500	386,400	88,450	50,000	2,545,750
1885–'86	825,050	290,400	377,000	540,600	48,400	37,500	2,127,950
1886–'87	950,000	500,000	525,000	475,000	80,000	50,000	2,580,000
1887–'88	959,156	392,824	428,616	441,342	140,742	119,260	2,481,940
1888–'89	990,604	466,767	523,242	526,387	145,804	133,040	2,785,844
1889–'90	1,364,607	787,989	753,078	465,000	221,480	135,813	3,627,967

Germany produces about one third, heading the list of producing countries. Austria and France are large producers, and Russia has more than doubled production in a dozen years. The average product of four years, prior to the campaign just closed, is 2,493,936

metric tons, or 5,498,131,306 pounds. A comparison of imports and exports shows that this product more than sufficed for the consumption of the continent. The net exports of recent years average nearly 1,500,000,000 pounds, making the consumption about 4,000,000,000 pounds annually. With increase of production and prevailing cheapness, however, consumption is doubtless now increasing materially. The rate of consumption differs greatly in the different countries, being very low in Russia and Italy, Spain and Portugal; much larger for France and Germany and Scandinavia, though these countries scarcely use a third as much as Great Britain.

For the purpose of closely approximating the annual consumption of sugar in Europe, and of determining how much, in recent years, is beet sugar and how much cane sugar, the customs records of 1886 to 1888, inclusive, have been searched, and imports and exports of each country ascertained and reduced to pounds from the original kilograms, hundred weights, poods, and other measures. An annual average of three years eliminates much of the effect of the annual fluctuation, and determines more closely the annual consumption, which is made up of the two elements—production and importation.

The following table shows, for the years indicated, the average annual imports of sugar into the countries named, with the average annual exports therefrom for the same periods respectively. It also shows the net imports or the net exports, as the case may be, for each country, with the general net imports for the whole of Europe.* The figures for Austria-Hungary, Germany, Roumania, and Switzerland include molasses, and to that extent overstate the sugar trade. All the figures are taken directly from the official documents of the respective countries with the exception of those for Russia and Switzerland, which are from the British "Statistical Abstract for the Principal and other Foreign Countries." The foreign denominations are here reduced to their equivalents in pounds:

Countries.	Years.	Annual average.			
		Imports.	Exports.	Net imports.	Net exports.
		Pounds.	*Pounds.*	*Pounds.*	*Pounds.*
Austria-Hungary	1886, 1887, and 1888.	2,362,964	515,840,906	.....	513,477,942
Belgium	....do	30,164,776	218,921,270	.....	188,756,494
Denmark	....do	41,477,309	5,264,461	36,192,848	.....
France	....do	397,578,141	397,925,353	49,652,788	.....
Germany	....do	15,541,695	1,397,216,691	.....	1,381,674,996
Great Britain and Ireland	....do	2,697,017,456	111,136,032	2,585,881,424	.....
Greece	1887 and 1888.....	14,937,983	.....	14,937,983	.....
Italy	1886, 1887, and 1888.	174,577,644	219,137	174,358,507	.....
Netherlands	1887 and 1888.....	232,828,733	209,201,115	23,627,623	.....
Portugal	1886, 1887, and 1888.	54,358,528	.....	54,358,528	.....
Roumania	1885 and 1886.....	19,909,633	1,976	19,907,657	.....
Russia	1885, 1886, and 1887.	.....	130,885,550	.....	130,885,550
Spain	1886, 1887, and 1888.	116,962,663	8,914	116,953,749	.....
Sweden and Norway:					
Sweden	1885, 1886, and 1887.	86,730,728	101,392	86,629,336	.....
Norway	1886, 1887, and 1888.	26,089,692	1,031,290	25,058,402	.....
Switzerland	1885, 1886, and 1887.	77,167,099	.....	77,167,099	.....
Total	.....	3,977,704,749	2,927,774,087	3,264,725,644	2,214,794,982

This table shows that the continent has had, for three years at least, a surplus sufficient for more than half of the requirements of

*Montenegro, Servia, and Turkey, with its tributary States, are the only European countries not included. For these no statistics are available.

consumption in Great Britain. The details of exportation of Germany and other beet-sugar countries show that the larger portion of their shipments abroad goes to Great Britain. The difference between these aggregates of exports and imports, 1,049,930,662 pounds, is presumed to represent approximately the share of cane sugar in recent consumption, say one sixth to five sixths of beet sugar. At the same time the past year's product is more than a million tons in excess of the consumption of the continent and British Isles together; the excess over recent years is twice as much as the net importation into Europe. In view of this fact, it is safe to say, for the present at least, that in Europe production has outrun consumption, with a prospect of having a constant surplus for other continents.

The farmers of the country have some responsibility in the development of the sugar industry. The product can not be made without beets, which must come from the fields of the farms. The value of the roots depends upon their content of sugar, which depends in turn upon seed, soil, fertilization, and cultivation. This difference may vary a dollar or more per ton and represent all the possible profit in their production. Hence the farmer has a large stake in the skill and technical knowledge which yields the best results. As he must learn the requirements of the plant and the details of its treatment, he must not expect to escape reduction of his profits as a necessary penalty for the blunders of his apprenticeship. The most extensive preparations for beet-sugar production, east of the Rocky Mountains, were made this season at Grand Island, Nebraska, and Medicine Lodge, Kansas. At the latter place beet sugar was made last year. The results in Nebraska are so favorable that new plants and more extended operations are planned.

The prevailing error in agricultural practice, as in some other lines of effort in this country, is to look only to the present hour, and get the largest return to-day, without a thought of the future. The beet-sugar industry involves something more than the price of a ton of beets the present year. It includes—

(1) Rotation, which insures large yields and clean cultivation.

(2) Symmetry in rural development, variety in production.

(3) Fertilization, providing in large degree the material through cattle feeding.

(4) Fine tilth and thorough cultivation.

(5) Increased value of land, from its enlarged capacity for production, and the cheapening of cost of product and resulting increase of net profit.

It would be easy to show the relative advance in value of lands in beet-sugar districts, the increase of agricultural wealth, and the general prosperity enhanced by this industry. Rotation is a necessity, the soil must be enriched, though fertilizers must be applied to preceding crops and not to the crop of beets directly. Sugar-beet culture is only one link in the chain of production which gives variety and prosperity to agriculture.

AGRICULTURE OF CANADA.

The Dominion of Canada comprises the provinces of Quebec, Ontario, Nova Scotia, New Brunswick, Manitoba, British Columbia, Prince Edward Island, and the Northwest territories. It comprises the whole northern half of North America, except Alaska on the

west, and Labrador, which belongs to the Government of Newfoundland, on the east, and in extent of territory is nearly as large as the States. The area of the whole continent of Europe exceeds it by less than 250,000 square miles. Such a comparison, however, is of little consequence, as a very large proportion of this vast territory lies in a cold, inhospitable climate, not suitable for habitation by civilized man, along the shores of the Northern Ocean and portions of Hudson Bay.

The area of the Dominion is so great that its general features of soil and climate are wonderfully varied, ranging from smiling and fertile agricultural areas to barren wastes, and from meteorological conditions resembling those which prevail over the British Isles to those of the Arctic region. Vast forests once covered practically the whole of Canada from the Atlantic Ocean to the Northwest boundaries of the Province of Ontario, and the face of the country in some districts is yet heavily wooded, the wealth of timber being one of the principal resources of many of the provinces. The soil underlying this virgin forest has been found very fertile and well adapted to a varied agriculture.

No census of the population of the Dominion has been taken since April 4, 1881, when it aggregated 4,324,810, an increase of 18.97 per cent during the preceding ten years. This census returned 1,390,604 persons as engaged in some occupation, or slightly more than one third of the total population. The proportion is almost exactly the same as the census of 1880 returned for this country, and the figures show that among the people of both countries there are very few drones in the national hive. Classifying the occupations of the people in accordance with our own classifications, the proportion engaged in different occupations in each country is as follows:

Occupations.	Canada.	United States.
Agriculture	55.9	44.1
Trade and transportation	9.1	10.4
Industrial	24.2	22.1
Professional and domestic	10.8	23.4

This statement would seem to show that the distribution of the workers of the two countries in trade and industrial pursuits is in about the same proportion, but there is a marked disparity in the proportions engaged in rural and professional pursuits. Considerably more than half of the Canadian population is dependent upon the bounty of the soil, a proportion too large for that harmonious development of resources necessary to the highest national prosperity.

Canada is essentially an agricultural country. The staple products are wheat, barley, oats, pease, corn, hay, potatoes, turnips, and live stock. But the lack of data of production for some provinces makes it impossible to present detailed estimates of the crops of the Dominion. It appears that the annual wheat crop amounts to between 35 and 40 million bushels, of which Ontario and Manitoba grow the largest proportion. The soil of these districts is admirably adapted to the cultivation of this cereal. The fields of Manitoba adjoin and are much similar to the American wheat districts of the Red River Valley and North Dakota, in Dakota, and the natural productiveness of this district is hardly exceeded by any wheat fields of the world. Oats

make up the largest bulk of the grain crops of the Dominion, this cereal flourishing best near the northern limit of its habitat. Barley is the cereal grown for foreign markets, the soil and climate being admirably adapted to its cultivation. The whole product of Canada has been estimated at 28,000,000 bushels. The United States has been the great market for Canadian barley; it is the only cereal which this country finds it necessary to purchase abroad. Taking the Canadian trade figures the following table is made showing the total shipment of home-grown barley during five years past and the amount of that total taken by the United States:

Years.	Total exports.	Taken by United States.
	Bushels.	*Bushels.*
1885	9,067,395	9,028,314
1886	8,554,302	8,528,287
1887	9,456,964	9,437,717
1888	9,370,158	9,360,521
1889	9,948,207	9,934,501

The foreign trade of the Dominion is carried on almost exclusively with the United States and Great Britain, the imports and exports to and from these two countries during 1887–'88 amounting to 88 per cent of the aggregate trade. A larger proportion of the exports alone went to these two countries, the proportion for the same years amounting to 91.52 per cent; Newfoundland, South America, and the West Indies took 5.95 per cent, leaving only 2.53 per cent to be divided among the remaining countries of the world. The trade with the United States alone amounts to almost half of the total, and yet, according to the official figures of this country, our trade with Canada constitutes only about 6 per cent of our total. In 1889 the Dominion records credit us with a balance of trade of $12,846,586, while the balance of trade in favor of Great Britain was only $4,144,429 for the same year. The records of our Government show a slight balance in favor of Canada. As this country, according to their records, ranks first in both the import and export trade of Canada, the following tables, prepared from the reports of the Bureau of Statistics of the Treasury Department, giving an itemized statement of the trade, exclusive of bullion for 1889, will be found interesting. The exports are of domestic merchandise only.

Items.	Quantity.	Value.
EXPORTS.		
Agricultural implements		$132,550
Animals, living		546,778
Breadstuffs		9,393,727
Coal	tons.. 1,370,119	5,357,285
Cotton, raw	bales.. 61,503	2,980,556
Hides and skins		451,171
Iron and steel, and manufactures of		2,368,147
Leather, and manufactures of		944,485
Illuminating oil	gallons.. 4,828,779	479,499
Provisions		6,876,684
Tobacco, leaf	pounds.. 3,843,473	732,810
Wood and manufactures		2,624,511
All other articles		6,076,043
Total		98,279,044

Items.	Quantity.	Value.
IMPORTS.		
Animals, living		$5,199,713
Barley	bushels.. 11,365,881	7,721,475
Coal	tons.. 434,741	1,842,466
Copper and copper ore		313,924
Eggs	dozen.. 15,870,061	2,845,715
Fish		2,765,521
Flax	tons.. 2,168	339,545
Hay	do.... 105,220	1,081,802
Malt, barley	bushels.. 136,256	100,314
Tobacco, leaf	pounds.. 816,197	421,795
Wood, and manufactures of		11,852,488
Wool	pounds.. 1,108,226	218,324
All other articles		7,746,189
Total		41,949,221

AGRICULTURE OF MEXICO.

The Government of Mexico publishes statistics of agricultural production, as follows:

Crop.	Value.	Producing States.
	Pesos.	
Cotton	10,857,000	Coahuila, Durango, Chihuahua, Vera Cruz, Colima, Jalisco, Guerrero, Michoacan, Oaxaca, Sonora, Tamaulipas, Nuevo Leon, and Hidalgo.
Rice	1,246,000	Vera Cruz, Colima, Michoacan, Chiapas, Guerrero, Oaxaca, Tampico, Sonora, Yucatan, and Morelos.
Indigo	372,910	Oaxaca, Chiapas, Guerrero, Vera Cruz, Sonora, and Colima.
Cocoa	1,135,360	Tabasco, Chiapas, Oaxaca, and Vera Cruz.
Coffee	3,200,000	Vera Cruz, Oaxaca, Morelos, Michoacan, Colima, and Chiapas.
Tobacco	2,500,000	Vera Cruz, Tabasco, Campeche, Yucatan, Chiapas, Oaxaca, Guerrero, Jalisco, Sinaloa, and Colima.
Cochineal	111,910	Oaxaca.
Vanilla	900,000	Vera Cruz, Oaxaca, Tamaulipas, Tabasco, Guerrero, Michoacan, Jalisco, and Colima.
Sarsaparilla	200,000	Vera Cruz.
Hennequen	3,718,750	Yucatan and Campeche.
Ixtle	700,000	
Cane or sugar	8,735,000	Morelos, Vera Cruz, Puebla, Oaxaca, and Yucatan.
Total special	32,676,930	
Maize	110,000,000	Mexico in general.
Beans	8,000,000	
Pease	450,000	
Chick pease	500,000	
Anise	105,000	
Barley	4,500,000	
Wheat	18,400,000	
Sesame	200,000	
French beans	500,000	
Allspice (Chili)	455,000	
Lentils	100,000	
Potatoes	600,000	
Total general	147,455,000	

The pesos is worth about 83 cents in our money. The products of the maguey plant, which are of considerable value, are not included, as also other minor products.

Valuable forest products are sources of considerable income, and will prove of great value in the future. Mahogany, ironwood, teak, ebony, cedar, logwood, and many other valuable woods abound. Among fruits may be mentioned the orange, lemon, citron, date, guava, pineapple, tamarind, banana, mangrove, melon, and many others.

SOUTH AMERICAN STATISTICS.

ARGENTINE REPUBLIC.

Previous to 1810 agriculture neither did nor could exist in the territories which now form the Argentine Republic, the cultivation of the principal cereals being then forbidden under Spanish law, with a view to compelling the colonists to obtain their breadstuffs from Europe. With the establishment of independence in the year named grain began to be cultivated a little, but it is only since the inauguration of the constitutional era (in 1853) that agriculture has begun to assume a certain importance.

The following table shows by provinces and territories, the area of cultivated land in the Argentine Republic, and the percentage which this land is of the total area:

Provinces and territories.	Area under cultivation.		Per cent of total area.
	Hectares.	*Acres.*	
Provinces:			
Buenos Ayres	932,591	2,304,432	3.1
Santa Fé	586,537	1,449,333	5.9
Entre Rios	136,151	336,429	1.7
Corrientes	46,631	115,225	1.3
Cordova	234,395	579,100	0.5
San Luis	19,869	49,096	0.2
Mendoza	88,546	218,797	0.5
San Juan	79,715	196,976	0.8
La Rioja	22,217	54,898	0.2
Catamarca	44,618	110,251	0.5
Santiago	120,400	297,509	1.2
Tucuman	35,943	88,815	1.5
Salta	40,256	99,473	0.3
Jujui	18,994	46,934	0.4
Territories:			
Missiones	4,606	11,382	0.1
Formosa	648	1,601	.....
Chaco	3,623	8,953	.....
Pampa Central	5,864	14,490	.....
Rio Negro	1,291	3,190	.....
Total	2,422,995	5,987,221	1.1

The areas under the various crops, with the percentage which each one forms of the total crop area, according to the agricultural and live stock census of October, 1887, are as follows:

Crops.	Areas cultivated.		Per cent of total area.
	Hectares.	*Acres.*	
Wheat	815,428	2,014,947	33.6
Maize	801,583	1,980,712	33.1
Alfalfa	390,009	963,712	16.1
Flax	121,073	299,171	5.0
Barley	28,672	70,849	1.2
Vines	23,345	57,685	1.0
Sugar cane	21,062	52,044	2.8
Potatoes	14,137	34,933	
Peanuts	6,794	16,788	
Kidney beans	6,775	16,741	
Manioc	4,742	11,717	
Sweet potatoes	3,757	9,284	
Canary seed	3,456	8,540	
Tobacco	3,234	7,991	
Oats	2,371	5,859	
Rice	1,286	3,178	
Vegetables and various crops	175,261	433,070	7.2
Total	2,422,995	5,987,221	100

It has been stated that the quantity of rainfall diminishes as the distance from the Atlantic increases, until finally irrigation becomes esseutial to successful agriculture. The following figures show the area irrigated, or suitable for irrigation by the construction of canals, so far as reported in the census:

Provinces and territories.	Area.	
	Hectares.	*Acres.*
Provinces:		
Buenos Ayres	115,351	285,032
Corrientes	18,893	46,685
San Juan	79,715	196,976
La Rioja	13,491	33,336
Catamarca	24,237	59,890
Tucuman	74,648	184,455
Salta	96,321	238,009
Jujui	67,271	166,227
Territories:		
Missiones	92	227
Pampa Central	58	143
Rio Negro	1,440	3,558
Total	*492,417	1,216,762

*The actual sum of the items given above is 491,517 hectares (1,214,538 acres).

The following comparison between 1877 and 1887 in respect to the quantities of some of the leading agricultural products exported in those two years, respectively, shows how rapid must have been the growth in agricultural production during the intervening decade.

Products.	Quantities exported in tons of 1,000 kilograms (2,204.6 pounds).		Products.	Quantities exported in tons of 1,000 kilograms (2,204.6 pounds).	
	1877.	1887.		1877.	1887.
Wheat	200	237,866	Flax	.....	81,208
Flour	218	5,401	Potatoes	3	191
Maize	9,818	361,844	Bran	2,355	4,194
Barley	.....	820	Hay	6,722	12,375

The following table shows the number of animals, by provinces, as returned by the live stock census of 1887:

Provinces and territories.	Sheep.	Cattle.	Horses.	Goats.	Asses and mules.	Swine.
Provinces:						
Buenos Ayres	51,557,750	8,482,483	1,691,192	10,198	31,058	208,088
Santa Fé	2,977,382	2,328,443	528,536	13,310	7,766	58,530
Entre Rios	4,901,123	4,120,068	719,510	13,846	6,518	23,523
Corrientes	611,085	1,841,455	268,699	16,603	13,506	10,021
Cordova	2,355,030	2,110,523	403,879	630,264	47,197	22,253
San Luis	241,827	478,904	113,554	310,491	27,769	6,844
Mendoza	122,298	180,009	44,849	50,847	11,184	6,552
San Juan	62,670	54,530	25,848	25,347	21,154	3,625
Rioja	57,932	160,197	25,038	108,188	30,824	5,252
Catamarca	152,432	239,834	56,054	190,806	89,402	10,962
Santiago	781,951	588,396	110,368	308,993	27,498	13,093
Tucuman	43,390	198,835	42,939	26,299	14,805	7,129
Salta	256,695	267,225	34,174	84,567	39,603	7,194
Jujui	617,803	89,855	22,896	77,975	46,425	2,358
Territories:						
Missiones	4,218	41,967	17,541	3,279	1,096	3,961
Formosa	143	14,405	625	50	44	437
Chaco	3,751	17,551	1,597	500	365	892
Pampa Central	1,670,393	469,775	110,104	12,467	1,140	2,147
Rio Negro	287,940	77,434	16,620	715	50	864
Tierra del Fuego	282	148	9	10	.....	33
Total*	66,701,097	21,963,930	4,262,917	1,969,765	430,940	403,203

*The discrepancies between the sum of the items in each column and the totals given, appear in the original document.

There were 177,055 ostriches, of which 154,022 were in the province of Buenos Ayres, 10,077 in Corrientes, 4,787 in the Territory of Pampa Central, and the remainder scattered through various provinces and territories.

There were 47,738 llamas, of which all except 500, credited to Catamarca, were in the Province of Jujui, where they are used as beasts of burden.

Of cattle, sheep, and horses, as distributed into classes, there were the following numbers:

Classes of animals.	Cattle.	Sheep.	Horses.
Work animals	962,699	.....	1,047,769
Range stock:			
Common	17,574,572	24,317,214	2,951,182
Mixed breeds	3,388,801	42,002,867	259,009
Pure breeds	37,358	381,016	4,957
Total	21,963,980	66,701,097	4,262,917

Of mules there are reported 116,700, and of asses 47,887, work animals, making together 164,587 work animals out of a grand total of 430,940 of these classes.

Of pure breeds there were 1,617 goats and 3,594 swine, and of mixed breeds 15,469 goats and 88,678 swine; while of ostriches there were 2,119 imported African birds and 25,406 obtained by crossing the African bird with the indigenous one, the remaining being of the indigenous variety.

The average weight of beef cattle on the coast is from 125 to 150 kilograms (276 to 331 pounds) for cows, and from 200 to 250 kilograms (441 to 551 pounds) for oxen. The average weight of sheep is from 20 to 25 kilograms (44 to 55 pounds) for ewes and from 30 to 35 kilograms (66 to 77 pounds) for wethers. In the interior provinces, cattle stabled during the winter, or pastured on alfalfa, obtain a much greater weight.

Estimated according to the average value for each class of animals, the total value for each class and for the entire number is stated as follows:

Class.	Values.	
	Pesos nacionales.	*Dollars.*
Cattle	289,252,606	173,551,563.60
Sheep	147,233,702	88,340,221.20
Horses	46,283,094	27,769,856.40
Asses and mules	4,569,866	2,741,919.60
Swine	3,703,454	2,222,072.40
Goats	2,409,183	1,445,509.80
Ostriches	1,111,143	666,685.80
Llamas	238,322	142,993.20
Total	494,801,370	296,880,822.00

The number of poultry is reported as follows:

Barnyard fowl	4,249,754
Peafowl	556,776
Ducks	318,648
Geese	184,699
Pigeons	954,487

The provinces of Buenos Ayres and Santa Fé are richest in poultry. The following table shows the quantities of the principal animal products exported in the years 1878 and 1888, respectively.

	1878.		1888.	
	Kilograms.	*Pounds.*	*Kilograms.*	*Pounds.*
Wool	81,894,174	180,543,896	131,743,339	290,441,365
Sheepskins	27,848,592	61,395,006	28,054,616	61,849,206
Goatskins	609,808	1,344,383	770,366	1,698,349
Horse hair	1,910,885	4,212,737	2,019,212	4,451,555
Tallow	21,097,022	46,510,495	14,802,873	32,634,414
Jerked beef	33,600,293	74,075,206	26,449,055	58,309,587
Hides, dry and salt:		*Number.*		*Number.*
Of cattle		2,238,802		3,306,620
Of horses		201,959		356,505

VENEZUELA.

Coffee stands first among the productions of Venezuela which have a recognized commercial importance, and with the advance in prices maintained for some years past, plantations have been greatly extended. The excellence of the Venezuelan coffee, and that grown in the eastern part of Colombia adjacent, which is marketed in Maracaibo and passes as a product of the former country, is well known and strengthens the demand.

It is understood that Java and Mocha of commerce are not the originals of these favorite names, and do not come from the East Indies or Arabia, but mainly, if not entirely, from South America, Venezuela taking high rank in their production. The "La Guayra" and "Maracaibo" are still imported, but rarely if ever now known under these names. Cacao is another product largely grown and exported. There is plenty of land suitable for its extension, but laborers for its cultivation are scarce. There are herds of cattle and flocks of goats, which furnish, besides milk, meat, and cheese to the population, hides and skins for export and cattle for some of the beef markets of some of the West Indian islands. The beef is always of inferior quality, as the grass it is fed upon is coarse, and there is no grain feeding. The cattle which arrive at or are produced near the coast for home meat market or for export would not be considered as in good "store" condition in the United States, and their meat is so tough that a beefsteak is fortunately unknown. It is divided for sale into chunks with a common ax, and so as to give to each customer impartially his share of the bones.

The latest statistics of live stock are for 1886, as follows:

Classes.	Number.	Classes.	Number.
Horned cattle	5,275,481	Swine	1,439,185
Goats and sheep	4,645,858		
Horses and mules	622,306	Total	12,752,750
Asses	769,920		

According to the best authority at hand the foreign commerce of Venezuela for 1888—the latest statement—amounted to a total of $35,387,551, in which her export excess was $3,802,235, showing very favorable conditions. This commerce, as to leading countries and

the value of their respective exports and imports, may be tabulated as follows:

Imports from—	Value.	Exports to—	Value.
Great Britain	*$4,702,023	United States	$9,123,099
United States	3,948,765	France	3,041,962
Germany	2,692,080	Germany	2,009,377
France	2,530,355	Great Britain	1,349,845
United States of Colombia	869,095	All others	3,241,491
All others	1,050,340	Total exports	19,594,893
Total imports	15,792,658	Total trade	35,387,551

*Of this amount only $2,907,335 was of British products.

It will be seen from the foregoing that the United States purchases from Venezuela nearly as much as all other countries combined, while Venezuela purchases of us only a little more than 25 per cent of her importations, but buys considerably more than twice as much from three European countries as from us.

Character and value of imports from Venezuela into the United States during the year ending June 30, 1889.

Articles free of duty.	Value.	Articles paying duty.	Value.
Animals	$70	Books, maps, etc	$1,559
Cacao or cocoa	138,753	Carpet wool	223
Cinchona	3,099	Copper ore	54
Cocoanuts	6,291	Copper bars	35
Coffee (63,114,529 pounds)	9,138,591	Drugs and dyes	334
Cotton	10,135	Fish	2
Drugs and dyes	72,343	Fruits, preserved	24
Dyewoods	18,252	Furniture	7
Furs and skins	87	Hats	30
Goatskins	330,969	Lead, manufactures of	187
Guano	71,690	Metal, manufactures of	25
Hides	530,913	Musical instruments	208
Household goods	50	Oranges	31
Resins and gums	483	Sheep	25
Rubber, crude	38,157	Spirits	12
Seeds	371	Zinc, spelter, etc	4,009
Spirits, distilled	1,211	Total dutiable	6,800
Vegetable ivory	120	Add free articles	10,385,769
Woods	5,637	Total imports	10,392,569
All other articles	18,547		
Total free of duty	10,385,769		

Classes and value of exports of domestic products from the United States to Venezuela during the year ending June 30, 1889.

Articles.	Value.	Articles.	Value.
Breadstuffs:		Provisions, as meats, etc.:	
Corn	$118,724	Bacon and hams	$70,393
Wheat flour	791,007	Butter	109,440
All other	79,858	Lard	477,036
Chemicals, drugs, dyes, etc	137,265	All other	17,162
Cotton, manufactures of	467,141	Tobacco and manufactures of	87,825
Iron and steel, manufactures of	442,450	Wood, manufactures of	94,351
Oils, mineral, refined	121,849	Other merchandise	690,104
		Total exports	3,701,605

COLOMBIA.

Coffee is the principal product of Colombian plantations. The product could be immensely increased but for the scarcity of labor.

Cinchona has been next in importance until recently. Hides and skins now rank second. Besides these, products for consumption and exportation are cacao, cocoanuts, sugar, bananas, tobacco, and occasionally cotton and corn. There are also some foreign shipments of India rubber, vegetable ivory, dyewoods, and gold and silver. Other products for home use are rice, yams, sweet potatoes, and Egyptian corn.

Of the rice produced, in the region of Cartagena, the berry is so small that machinery has not been secured with which to successfully clean it. Some wheat is grown on the highlands, but it is not popular because its flour can not be made into light bread. As to cereal cultivation generally, the habits of the people, their farming implements, and the climate are against it. The plow used in Colombia and most of the tropics is the primitive, single-handle, wood plow of Algeria and Moorish Spain, oftenest without an iron shod point, drawn by oxen yoked across the forehead firmly with a piece of timber and a rope or piece of rawhide; and although this instrument may disturb the soil, it helps as little as its owner towards reliable, steady husbandry, such as is known alone to less enervating climes. Iron and steel plows have been introduced on some plantations, but have been invariably broken by the laborers at night, and abandoned. Just so was the first tramway torn up in Puerto Cabello.

The latest census of farm and range stock gives the following numbers:

Kinds of stock.	Number.	Kinds of stock.	Number.
Neat cattle	949,072	Goats	610,147
Horses	149,735	Swine	343,542
Mules	41,530	Sheep	41,696
Asses	13,090		

An attempt to show the foreign trade of Colombia for 1888 was made by United States Minister Abbott, derived from his inspection of the customs returns of the country, and his reports, corrected by the Department of State upon the authority of the customs returns of this country, Great Britain, and France, and from the Statesman's Year-Book as to the trade of Germany, are the basis of the following tables. The indirect trade through France was with Belgium and Switzerland; that through the United States and Great Britain was with unascertained countries.

Imports of Colombia, 1888.

From—	Direct.	Indirect.	Total.
France	$7,874,000	$2,026,000	$9,900,000
Great Britain	5,236,000	272,000	5,508,000
The United States	4,923,259	100,621	5,023,880
Germany	1,010,304	.....	1,010,304
The Antilles	225,701	.....	225,701
Ecuador	171,147	.....	171,147
Spain	122,156	.....	122,156
Peru	16,690	.....	16,690
Italy	9,824	.....	9,824
All other countries	97,088	.....	97,088
Total	19,686,169	2,398,621	22,084,790

Exports of Colombia, 1888.

Destination.	Value.	Destination.	Value.
United States	$1,393,258	Italy	$6,685
Great Britain	4,109,843	Spain	4,813
Germany	1,532,305	Ecuador	1,785
France ($9,036 Belgium)	1,159,894	Destination unknown:	
Antilles	181,220	Exports of Colon and Panama	1,682,293
Costa Rica	67,238	Exports of Ipeles and Cucuta	1,208,362
Venezuela	46,363		
Mexico	38,318	Total	14,551,076
Peru	18,690		

PAN-AMERICAN TRADE.

The interest manifested in the affairs of our neighbors of the Americas lying to the southward, and the importance of present trade relations with those countries, warrant a careful preparation of the facts of commercial exchanges with them. The following figures are taken from the official records of the Treasury Department, gathered by the Bureau of Statistics. The agricultural items in exports and imports are carefully segregated and presented separately. In the totals by countries the agricultural totals are placed side by side with the aggregates of all exports to or imports from the countries of South America, those of Central America, and the group of islands constituting the West Indies.

The following is a statement of our exports to the countries named and imports from those countries, during the last fiscal year:

Countries.	Agricultural.		Total.	
	Exports.	Imports.	Exports.	Imports.
Central America:	*Dollars.*	*Dollars.*	*Dollars.*	*Dollars.*
Costa Rica	351,366	1,380,382		
Guatemala	314,091	2,264,410		
Honduras	138,223	1,050,689	4,146,511	8,414,019
Nicaragua	283,413	1,016,099		
San Salvador	212,195	1,636,913		
British Honduras	191,448	180,524	362,623	211,465
Total	1,490,736	7,529,017	4,509,134	8,625,484
South America:				
Argentine Republic	304,102	5,193,741	8,376,077	5,454,618
Bolivia	2,100	1,477	762,546	
Ecuador	275,672	480,797		695,005
Chili	341,763	1 3,492	2,967,254	2,622,625
Brazil	4,903,421	52,642,737	9,276,511	60,408,804
French Guiana	82,943			
British Guiana	1,231,151	4,512,593	2,038,643	4,526,181
Dutch Guiana	171,760	458,925		460,243
Peru	112,531	202,965	773,244	314,032
United States of Colombia	984,115	3.669,996	3,728,961	4,263,519
Uruguay	360,412	2,847,828	2,027,383	2,986,964
Venezuela	1,805,194	10,156,454	3,703,705	10,392,569
Total	10,575,164	80,271,005	33,654,324	92,119,560
West Indies:				
Danish West Indies	335,959	513,787		
French West Indies	1,326,232	99,382		
British West Indies	5,539,461	14,579,986		
Dutch West Indies	365,121	90,123	29,941,525	77,947,333
Hayti	1,955,406	2,948,295		
San Domingo	390,845	1,285,873		
Cuba	5,099,954	47,294,203		
Porto Rico	1,327,026	3,672,274		
Total	16.340,004	70,483,923	29,941,525	77,947,333
Grand total	28,405,904	158,283,945	68,104,983	178,692,377

The value of exports to these countries is about three eighths of the value of imports from them. The exchange requires in cash, to settle the difference, more than $110,000,000. Almost four fifths of the great aggregate of imports is for sugar and coffee, the former mainly from the West Indies, the latter mostly from South America.

The total values of the different classes of agricultural exports from the United States to South American countries, for the fiscal year 1889, are as follows:

Countries.	Animals and their products.	Bread and breadstuffs.	Miscellaneous products.	Total agricultural exports.
Argentine Republic	$224,141	$11,491	$68,470	$304,102
Bolivia	2,100	.....	.....	2,100
Brazil	729,239	4,103,051	71,131	4,903,421
Chili	136,508	201,346	3,909	341,763
Peru	108,411	1,788	2,332	112,531
Colombia	426,950	388,700	168,465	984,115
Uruguay	46,061	283,258	31,093	360,412
Venezuela	691,082	989,589	124,522	1,805,194
Ecuador	207,398	66,269	2,005	275,672
French Guiana	44,687	27,989	10,317	82,943
British Guiana	559,967	594,241	76,943	1,231,151
Dutch Guiana	106,992	58,123	6,645	171,760
South America	3,283,537	6,735,795	565,832	10,575,164

TRANSPORTATION RATES.

There have been published in each monthly crop report during the year statements showing the rates of freight upon our principal products of agriculture, and farmers' supplies, by rail and water, from the important shipping points in all parts of the country to the large market centers; also the cost of transporting our surplus products to foreign countries. It is doubtless understood that these rates were those in operation upon the first day of each month, and did not show the changes occurring between the reports.

For the first five months of the year the rates from Chicago to New York and points taking New York rates, remained the same. The returns for June 1 showed a decrease of 5 cents per 100 pounds upon packing-house products, oats, and live hogs, and an increase of 15 cents upon wool. The application of the 3 cents differential to Boston by the Grand Trunk road, and the Wabash (Canadian Pacific Dispatch Line) claiming the same right, caused another reduction in rates, as shown by the returns July 1. Dressed meats dropped from 45 to 33 cents, wheat and flour from 25 to 22½, and live cattle from 26 to 19½ cents. The rate upon wool was decreased from 65 cents June 1 to 50 cents, the same rate reported January 1. From this cause a further reduction was reported August 1. Packing-house products were reduced from 25 to 23, dressed meats from 33 to 30, cattle from 19½ to 18, and hogs from 25 to 23 cents. The returns for September 1 showed only one change, *i. e.*, wool was reduced from 50 to 34½ cents per 100 pounds.

The following table shows the rates in operation January 1, 1890, upon a few of the more important articles of shipment from Chicago to Boston, New York, Philadelphia, and Baltimore, and the changes reported during the year:

[In cents per 100 pounds.]

Articles (carloads).	From Chicago to—											
	Boston.						New York.					
	Jan. 1.	June 1.	July 1.	Aug. 1.	Sept. 1.	Dec. 1.	Jan. 1.	June 1.	July 1.	Aug. 1.	Sept. 1.	Dec. 1.
Packing-house products	35	30	.....	28	.....	35	30	25	.....	23	.....	30
Dressed meats	48	.....	33	30	.....	45	45	.....	33	30	.....	45
Flour	30	.....	27½	.....	.....	30	25	.....	22½	.....	.....	25
Wheat, rye, and barley	30	.....	27½	.....	.....	30	25	.....	22½	.....	.....	25
Corn	25	.....	.....	.....	.....	27½	20	.....	.....	.....	.....	22½
Oats	30	25	.....	.....	.....	30	25	20	.....	.....	.....	25
Cattle	26	.....	19½	18	.....	26	26	.....	19½	18	.....	26
Sheep	30	.....	.....	.....	.....	.....	30	.....	.....	.....	.....	.....
Hogs	30	25	.....	23	.....	30	30	25	.....	23	.....	30
Wool	55	71	55	.....	39½	71	50	65	50	.....	34½	65

Articles (carloads).	From Chicago to—											
	Philadelphia.						Baltimore.					
	Jan. 1.	June 1.	July 1.	Aug. 1.	Sept. 1.	Dec. 1.	Jan. 1.	June 1.	July 1.	Aug. 1.	Sept. 1.	Dec. 1.
Packing-house products	28	23	.....	21	.....	28	27	22	.....	20	.....	27
Dressed meats	43	.....	31	28	.....	43	42	.....	30	27	.....	42
Flour	23	.....	20½	.....	.....	23	22	.....	19½	.....	.....	22
Wheat, rye, and barley	23	.....	20½	.....	.....	23	22	.....	19½	.....	.....	22
Corn	18	.....	.....	.....	.....	20½	17	.....	.....	.....	.....	19½
Oats	23	18	.....	.....	.....	23	22	17	.....	.....	.....	22
Cattle	24	.....	17½	16	.....	24	23	.....	16½	15	.....	23
Sheep	28	.....	.....	.....	.....	.....	27	.....	.....	.....	.....	.....
Hogs	28	23	.....	21	.....	28	27	22	.....	20	.....	27
Wool	48	63	48	.....	32½	63	47	62	47	.....	31½	62

RATES FROM MISSOURI RIVER POINTS.

The rates from Missouri River points to Chicago and St. Louis were for a portion of the year—from April to September—in a more demoralized condition than they were east of Chicago. Especially was this true of the rates upon packing-house products and cattle. To Chicago from Kansas City, Atchison, St. Joseph, and Omaha the rates upon the former for the five months ending with September 1 were reported at 12 cents per 100 pounds each month, and upon the latter they were from 12½ to 22 cents. June 1 the rates from Kansas City, Atchison, and St. Joseph to Chicago were reported at 12½ cents for cattle and 22½ cents for sheep and hogs, and to St. Louis, 9¼ cents for cattle, 14½ cents for sheep, and 13 cents for hogs, with a rebate of $7.35 per car, regardless of dimensions, to Chicago, and $4.80 to St. Louis.

The following statements are the carload rates, in cents per 100 pounds, as reported upon the first day of each month during the year 1890, from Missouri River points to Chicago and St. Louis:

Months.	To Chicago from— Kansas City, Atchison, and St. Joseph. Packing-house products.	Dressed meats.	Flour.	Wheat.	Other grain.	Cattle.	Sheep.	Hogs.	Omaha. Packing-house products.	Dressed meats.	Flour.	Wheat.	Other grain.	Cattle.	Sheep.	Hogs.
January 1	18	23½	22½	22½	20	9†	22	25	18	23½	25	25	20	25	25	25
February 1	18	18½	22½	22½	20	12½	22	25	18	23½	25	25	20	25	25	25
March 1	18	18½	22½	22½	20	12½	22	25	18	23½	25	25	20	25	25	25
April 1	18	18½	22½	22½	20	12½	22	25	18	23½	25	25	20	25	25	25
May 1	12	18½	22½	22½	20	12½	22	25	12	23½	25	25	20	*25	*25	*25
June 1	12	18½	22½	22½	20	*12½	*22	*22	12	18½	25	25	20	21	22	25
July 1	12	18½	22½	22½	20	18	*22	25	12	18½	25	25	20	21	22	25
August 1	12	18½	22½	22½	20	12½	22	22	12	18½	25	25	20	21	22	25
September 1	18	23½	22½	22½	20	22	25	25	18	23½	25	25	20	22	25	25
October 1	18	23½	20	†20	‡17	22	25	25	18	23½	20	†20	‡17	22	25	25
November 1	18	23½	20	†20	‡17	22	25	25	18	23½	20	†20	‡17	22	25	25
December 1	18	23½	20	†20	‡17	22	25	25	18	23½	20	†20	‡17	22	25	25

*Rebate of $7.35 per car, regardless of dimensions. †Wheat, rye, and barley. ‡Corn and oats.

Months.	To St. Louis from— Kansas City, Atchison, and St. Joseph. Packing-house products.	Dressed meats.	Flour.	Wheat.	Other grain.	Cattle.	Sheep.	Hogs.	Omaha. Packing-house products.	Dressed meats.	Flour.	Wheat.	Other grain.	Cattle.	Sheep.	Hogs.
January 1	13	18½	17½	17½	15	18	14½	21½	13	18½	20	20	15	16½	17½	17½
February 1	13	13½	17½	17½	15	13½	14½	21½	13	18½	20	20	15	16½	17½	17½
March 1	13	13½	17½	17½	15	7½	14½	21½	13	18½	20	20	15	16½	17½	17½
April 1	13	13½	17½	17½	15	9½	14½	21½	13	18½	20	20	15	16½	17½	17½
May 1	7	13½	17½	17½	15	9½	14½	21½	7	18½	20	20	15	*16½	*17½	*17½
June 1	7	13½	17½	17½	15	*9½	*14½	*13	7	13½	20	20	15	12½	14½	17½
July 1	7	13½	17½	17½	15	7½	*14½	21½	7	13½	20	20	15	12½	14½	17½
August 1	12	13½	17½	17½	15	7½	14½	21½	7	13½	20	20	15	12½	14½	17½
September 1	13	18½	17½	17½	15	18½	21½	21½	13	18½	20	20	15	13½	17½	17½
October 1	13	18½	15	†15	‡12	13½	17½	15	13	18½	15	†15	‡12	13½	17½	17½
November 1	13	18½	15	†15	‡12	18½	21½	21½	13	18½	15	†15	‡12	13½	17½	17½
December 1	13	18½	15	†15	‡12	13½	17½	15	13	18½	15	†15	‡12	13½	17½	17½

*Rebate of $4.80 per car, regardless of dimensions. †Wheat, rye, and barley. ‡Corn and oats.

REDUCTION IN ALL-RAIL RATES.

A glance at the following table shows what a heavy decrease there has been in the rates of freight upon corn and wheat since 1870. The rates for 1871 to 1873, inclusive, showed an increase over those for 1870, but from that time there has been a steady decline, and this year's average rate upon corn is the lowest ever reported. As compared with the rate for 1870, there is a decrease of nearly 60 per cent. The wheat rate is also the lowest, with the exception of the years 1884 and 1885, when the decrease was 56 per cent for both years as compared with 1870, against 52.1 per cent this year.

The following statement shows the *all-rail* rates in cents per bushel upon corn and wheat from Chicago to New York and upon grain per 100 pounds from St. Louis to New York for the years named:

[Average rate via all rail.]

Years	Chicago to New York.				St. Louis to New York.	
	Corn per bushel.		Wheat per bushel.		Grain per 100 pounds.	
	Average rate.	Per cent of decrease.	Average rate.	Per cent of decrease.	Average rate.	Per cent of decrease.
	Cents.		*Cents.*		*Cents.*	
1870	28.00	.....	30.00	.....	.....	.....
1871	29.68	*6.0	31.80	*6.0	.....	.....
1872	32.66	*16.6	34.99	*16.6	.....	.....
1873	28.93	*3.3	31.02	*3.4	.....	.....
1874	24.50	12.5	26.25	12.5	.....	.....
1875	22.40	20.0	24.00	20.0	.....	.....
1876	15.74	43.8	16.86	43.8	39¼	.....
1877	18.90	32.5	20.50	31.7	41	*3.8
1878	16.52	41.0	17.70	41.0	38	3.8
1879	14.56	48.0	17.74	40.9	33½	15.2
1880	17.48	37.6	19.80	34.0	42	*6.3
1881	13.40	52.1	14.40	52.0	32	19.0
1882	13.50	51.8	14.47	51.8	29½	25.3
1883	15.12	46.0	16.20	46.0	33	16.5
1884	12.32	56.0	13.20	56.0	26	34.2
1885	12.32	56.0	13.20	56.0	22½	43.9
1886	14.00	50.0	15.00	50.0	29	26.6
1887	14.70	47.5	15.75	47.5	32⅛	18.7
1888	13.54	51.6	14.50	51.7	29½	25.3
1889	12.82	54.2	15.00	50.0	†28½	27.8
1890	‡11.31	59.6	‡14.37	52.1	.....	.....

* Increase. † Corn 26 cents. ‡ Straight average.

MONTHLY RATES FROM CHICAGO.

To show a comparison of the rates upon some of the more important articles from Chicago to New York, as reported by the several trunk lines upon the first day of each month for a series of years, the following statement is presented:

[In cents per 100 pounds.]

Months.	Cattle, carload.					Sheep, carload.					Hogs, carload.				
	1886.	1887.	1888.	1889.	1890.	1886.	1887.	1888.	1889.	1890.	1886.	1887.	1888.	1889.	1890.
January 1	25	35	35	22½	26	25	45	40	30	30	30	35	30	30	30
February 1	25	35	35	22½	26	25	45	40	30	30	30	35	30	30	30
March 1	35	35	35	22½	26	45	45	40	30	30	30	35	30	30	30
April 1	35	35	35	22½	26	45	45	40	30	30	30	35	30	30	30
May 1	35	35	35	26	26	45	40	40	30	30	30	35	30	30	30
June 1	35	35	25	26	26	45	40	25	30	30	30	35	30	30	25
July 1	25	35	16½	26	19½	45	40	25	30	30	30	30	30	30	25
August 1	35	25	5½	26	18	45	40	25	30	30	30	30	18	30	23
September 1	35	35	10	26	18	45	40	25	30	30	30	30	18	30	23
October 1	35	35	15	26	18	45	40	25	30	30	30	30	18	30	23
November 1	35	35	15	26	18	45	40	25	30	30	30	30	30	30	23
December 1	35	16½	15	26	26	45	19	25	30	30	30	30	25	30	30

Months.	Grain and flour, carload.*					Packing-house products, carload.					Dressed beef, carload.				
	1886.	1887.	1888.	1889.	1890.	1886.	1887.	1888.	1889.	1890.	1886.	1887.	1888.	1889.	1890.
January 1	25	30	27½	25	25	30	35	33	30	30	43½	65	65	50	45
February 1	25	30	27½	25	25	30	35	33	30	30	43½	65	65	50	45
March 1	25	30	27½	25	25	30	35	33	30	30	65	65	65	50	45
April 1	25	30	25	25	25	30	35	30	30	30	65	65	65	50	45
May 1	25	25	25	25	25	30	30	30	30	30	65	65	65	50	45
June 1	25	25	25	25	25	30	30	30	30	25	65	65	65	45	45
July 1	25	25	25	25	22½	30	30	30	30	25	65	65	26½ to 40	45	33
August 1	25	25	25	25	22½	30	30	18	30	23	65	65	7	45	30
September 1	25	25	25	25	22½	30	30	18	30	23	65	65	25	45	30
October 1	25	25	20	25	22½	30	30	18	30	23	65	65	35	45	30
November 1	25	25	20	25	22½	30	30	30	30	23	65	65	35	45	30
December 1	25	25	20	25	25	30	30	25	30	30	65	31	35	45	45

* Not including unground corn after August 1, 1889. From August 1, 1889, to November 1, 1890, the rate on corn was 20 cents per 100 pounds, and December 1, 1890, 22½ cents.

LAKE AND CANAL RATES.

The rates upon corn and wheat via lakes, Chicago to Buffalo, were much lower during 1890 than they were during 1889. In the early part of the season, in fact before navigation was fairly opened, or shippers of ore or other products were ready for business, there was a great demand for loads at the larger ports by the vessel men. This caused a temporary glut of tonnage at Chicago, which reduced rates upon all classes of lake traffic. Oats were carried in May from Chicago to Buffalo as low as $1\frac{3}{8}$, corn $1\frac{1}{4}$, and wheat $1\frac{1}{2}$ cents per bushel. Later in the season, June and July, the rates were somewhat higher, but for the entire season of navigation they were quite low.

Rates via Erie Canal, Buffalo to New York, were also much lower the past season than they were during 1889. Unlike the lake rates, they opened strong, and remained quite steady throughout the season.

Statement showing the weekly range of rates of freight upon corn and wheat, Chicago to New York, via lakes and canal, for the years 1888, 1889, *and* 1890.

[In cents per bushel.]

Week ending–	Lake, Chicago to Buffalo.						Erie Canal, Buffalo to New York.						Chicago to New York, lake and canal.					
	1888.		1889.		1890.		1888.		1889.		1890.		1888.		1889.		1890.	
	Wheat.	Corn.	Wheat.	Corn.	Wheat.	Corn.	Wheat.	Corn.	Wheat.	Corn.	Wheat.	Corn.	Wheat.	Corn.	Wheat.	Corn.	Wheat.	Corn.
May 10	2	1⅞	2½	2	1⅞	1½	5	....	4	3⅝	4	3⅝	7	....	6½	5⅝	5½	5½
17	2	1¾	2¼	2	1½	1½	3	2½	4	3⅝	4	3⅝	5	4½	6½	5¾	5⅝	5½
24	2½	2	2	1⅞	1½	1½	2⅝	2⅝	4	3⅝	4	3⅝	5½	4⅝	6	5⅝	5½	4½
31	2½	2	2½	2	1½	1½	3½	3	4	3⅝	3⅝	3⅝	5½	5	6½	5⅝	5½	4⅝
June 7	....	2	2½	2	....	....	3⅝	3½	4	3⅝	....	....	....	5½	6½	5⅝	....	....
15	2	1½	2½	2	....	....	2⅝	2½	3⅝	3⅜	....	....	4⅝	4	6	5⅝	....	....
22	1⅝	1½	2	1⅝	....	....	2½	1⅝	3½	3⅜	....	....	3⅝	3⅝	5½	5½	....	....
30	2½	2	2	1½	....	....	2½	2	3⅝	3⅜	....	....	4⅝	4	5⅝	5½	....	....
July 7	2½	2	2	1½	2⅝	2⅝	2½	2	3⅝	3⅝	3⅝	3½	4⅝	4	5⅝	5½	6½	5½
14	1⅝	1½	2⅝	2	2½	2	2½	2½	3⅝	3⅝	3⅝	3⅝	4⅝	3⅝	6	5⅝	5⅝	5⅝
22	....	2	2½	2	2½	2	2½	2½	3⅝	3⅝	3⅝	3⅝	....	4½	6	5⅝	5⅝	5⅝
29	....	2½	2	1⅝	2½	1⅝	2⅝	2⅝	4	3⅝	3⅝	3½	....	4⅝	6	5⅝	5⅝	5
Aug. 7	2½	2½	2½	2	1½	1½	3½	3½	4	3⅝	3⅝	3½	6½	5⅝	6½	5⅝	5½	4½
15	3	2½	2½	2½	1½	1½	4½	4	4	3⅝	4	3½	7½	6⅝	6½	5⅝	5½	4⅝
23	3½	3	2½	2½	1½	1½	4⅝	3½	4	3⅝	4	3½	7⅝	6½	6½	6⅛	5½	4½
30	3½	3	3	2⅝	1½	1½	4⅝	3⅝	4½	4	4	3½	7⅝	6⅝	7½	6⅝	5½	4⅝
Sept. 7	3½	3½	2⅞	2⅝	1⅝	1⅝	3½	3½	4½	4	4	3½	7⅝	6¾	7⅝	6⅝	5⅝	4⅝
15	3⅝	3½	2⅞	2⅝	2	1½	3½	3½	5	4½	3⅝	3⅝	7½	6½	7⅝	7⅛	5⅝	5⅛
22	3⅝	3½	2½	2⅝	2	1⅝	4	3⅝	5	4½	3½	3⅝	7½	7⅛	7⅝	7⅛	5⅝	5½
29	3½	13	3	2½	2	1⅝	3⅝	3½	5	4½	3⅝	3⅝	7	6½	8	7½	5⅝	5⅝
Oct. 7	3	2½	3	2⅝	2½	2	3½	3½	5	4½	3⅝	3½	6⅝	5⅝	8	7½	6	5½
14	2½	2½	3	2⅝	2½	1⅝	3⅝	3⅝	5	4½	3⅝	3½	6½	5⅝	8	7½	5⅝	5⅝
22	2½	2	3	2⅝	1⅝	1½	3⅝	3½	5	4½	4½	3⅝	6	5½	8	7½	5⅝	5
29	2½	2	3½	2⅝	1½	1½	4	3⅝	5	4⅝	4½	3⅝	6½	5⅝	8½	7⅝	6	5½
Nov. 7	2⅝	2⅝	3	2⅝	1½	1½	4⅛	3⅝	5	4⅝	4½	3⅝	6⅝	5⅝	8	7	6	5½
15	2½	2	2	1⅝	2	1⅝	2⅝	2½	5	4⅝	3½	3	5	4⅝	7	6⅛	5⅛	4⅝
22	2	1⅝	2½	2½	1⅝	1½	4½	3½	5	4⅝	3	2½	6½	5½	7½	6⅝	4½	4
30	....	4	....	....	3½	3½	....	....	....	....	....	....	....	....	....	....	....	....

TRANSATLANTIC RATES.

Ocean freight rates generally have been much lower than they were for the year 1889. For the first four months of the year, or until about May 1, the rates were considerably higher, but from that time they decreased very rapidly, making the average for the year nearly 30 per cent lower than the average for the previous year. A prominent showing of this is found in the following comparative statement of the rates upon a few of the more important articles of export from

New York to Liverpool, as compiled from the returns from several of the larger steamship companies:

Articles.	January.		February.		March.		April.		May.		June.	
	1889.	1890.	1889.	1890.	1889.	1890.	1889.	1890.	1889.	1890.	1889.	1890.
Wheat, per bushel..	$0.08	$0.11	$0.08⅛	$0.11	$0.08	$0.10	$0.06	$0.07	$0.05	$0.04	$0.07	$0.04
Corn, per bushel....	.08	.11	.08½	.11	.08	.10	.06	.07	.05	.04	.07	.04
Flour, per barrel...	.60	.72	.60	.72	.60	.72	.48	.60	.36	.36	.48	.36
Bacon, per 2,240 lbs.	6.00	7.80	6.00	8.40	6.00	7.20	4.80	7.20	4.20	3.60	4.20	3.00
Lard, per 2,240 lbs..	6.00	7.80	6.00	8.40	4.80	6.60	4.80	5.40	3.60	3.00	4.20	3.00
Beef, per tierce	1.20	1.44	1.20	1.44	.96	1.32	.72	1.08	.72	.60	.72	.48
Pork, per barrel....	.84	.96	.84	.96	.72	.84	.54	.84	.48	.48	.60	.36
Cotton, per pound..	.00 7/16	.00 7/16	.00½	.00½	.00⅜	.00 7/16	.00⅜	.00 5/16	.00¼	.00 3/16	.00 7/32	.00 5/16
Apples, per barrel..	.72	.72	.72	.72	.66	.72	.60	.72	.60	.72	.60	.48
Butter, per 2,240 lbs.	9.60	9.60	9.60	10.80	9.60	9.60	8.40	8.40	7.20	7.20	8.40	7.20

Articles.	July.		August.		September.		October.		November.		December.	
	1889.	1890.	1889.	1890.	1889.	1890.	1889.	1890.	1889.	1890.	1889.	1890.
Wheat, per bushel..	$0.06	$0.05	$0.09	$0.05½	$0.08	$0.03	$0.11	$0.03	$0.11	$0.03	$0.10	$0.06
Corn, per bushel....	.06	.05	.09	.05½	.08	.03	.11	.03	.11	.03	.10	.06
Flour, per barrel..	.50	.36	.60	.36	.72	.24	.72	.24	.72	.36	.72	.48
Bacon, per 2,240 lbs.	4.20	3.60	5.32	3.00	6.00	2.40	7.20	2.40	7.80	2.40	8.40	4.80
Lard, per 2,240 lbs..	4.20	3.60	4.80	3.00	6.00	2.40	7.20	2.40	7.80	2.40	8.40	4.20
Beef, per tierce	.84	.60	.96	.48	1.20	.48	1.32	.48	1.44	.48	1.50	.72
Pork, per barrel....	.60	.48	.72	.36	.72	.36	.96	.25	.96	.36	1.08	.48
Cotton, per pound..	.00 5/16	.00 3/16	.00⅜	.00 5/16	.00¾	.00½	.00⅝	.00 5/16	.00¾	.00¼	.00 7/16	.00¼
Apples, per barrel..	.60	.60	.72	.72	.72	.60	.72	.60	.72	.48	.72	.48
Butter, per 2,240 lbs.	8.40	8.40	8.40	6.00	9.60	7.20	10.80	7.20	10.80	6.00	10.80	7.20

For comparison and record the following tables, showing the annual average rates upon wheat and the monthly average rates upon grain from New York to Liverpool for a series of years, are presented:

Average cost per bushel for transporting wheat from New York to Liverpool for the years 1866–'90.

Years.	Steamer rates.		Years.	Steamer rates.	
	Pence.	*Cents.*		*Pence.*	*Cents.*
1866	4.74	9.48	1879	6.20	12.40
1867	5.18	10.36	1880	5.88	11.76
1868	7.18	14.36	1881	4.08	8.16
1869	6.40	12.98	1882	3.87	7.74
1870	5.78	11.56	1888	4.54	9.08
1871	8.16	16.32	1884	3.40	6.80
1872	7.64	15.28	1885	3.60	7.20
1873	10.56	21.12	1886	3.46	6.92
1874	9.08	18.16	1887	2.71	5.42
1875	8.07	16.14	1888	2.67	5.34
1876	8.02	16.04	1889	4.06	8.12
1877	6.93	13.86	1890	*2.96	*5.92
1878	7.61	15.22			

* Straight average.

Average monthly price paid per bushel for carrying grain from New York to Liverpool for the years 1886–'90.

Months.	1886.		1887.		1888.		1889.		1890.	
	Pence.	*Cents.*	*Pence.*	*Cents.*	*Pence.*	*Cents.*	*Pence.*	*Cents.*	*Pence.*	*Cents.*
January	3.37	6.75	4.91	9.83	2.41	4.82	4.16	8.33	5.33	10.66
February	2.33	4.66	3.66	7.33	1.83	3.66	4.33	8.67	5.41	10.83
March	2.41	4.83	3.16	6.33	.83	1.66	3.96	7.92	5.00	10.00
April	3.66	7.33	1.50	3.00	.48	.87	2.91	5.83	3.50	7.00
May	3.79	7.58	1.58	3.16	.62	1.25	2.50	5.00	2.00	4.00
June	4.75	9.50	2.12	4.25	1.66	3.33	3.41	6.88	2.00	4.00
July	2.83	5.66	2.62	5.25	1.75	3.50	3.00	6.00	2.33	4.66
August	1.83	3.66	3.00	6.00	2.33	4.66	4.33	8.67	2.66	5.33
September	2.66	5.33	1.83	3.66	5.33	10.66	4.08	8.17	1.50	3.00
October	4.00	8.00	2.00	4.00	4.50	9.00	5.41	10.83	1.50	3.00
November	4.25	8.50	3.50	7.00	4.50	9.00	5.58	11.17	1.29	2.58
December	4.66	9.33	3.00	6.00	5.87	11.75	5.00	10.00	3.00	6.00

REPORT OF THE MICROSCOPIST.

SIR: I have the honor to submit herewith my nineteenth annual report upon the work done in the Division of Microscopy. This work relates largely to the microscopy of foods, food fats, and oils.

A number of lard compounds have been examined and reported on, at the special request of the Agricultural Committee of Congress. I have also investigated a number of samples of various brands of lard and lard compounds for and at the request of the Executive Committee of the National Grange of Virginia. Certain fibers have been investigated for and at the request of the Secretary of the Treasury, and also a different class of fibers for and at the request of the Postmaster-General.

I have brought to completion my invention for testing the tensile strength of textile fibers, and it will be used during the current year.

The miscellaneous work of the Division has varied from the examination of suspected butters from dealers and others to investigation of the material of wrappers of cheap cigars sold at 2 cents apiece, and includes special work as may be required for other Divisions of the Department.

As much interest has been manifested by our correspondents in the United States in relation to my paper on the edible mushrooms of the United States and their cultivation, I have prepared, with the approval of the Assistant Secretary, a more extended paper on this subject, with additional illustrations of both edible and poisonous varieties, including an account of the various European methods of mushroom culture. Specimens of edible and poisonous mushrooms have been received from Alabama, Ohio, Virginia, Maryland, and the District of Columbia.

Samples of pure fish liver oils of many varieties, have been received from Hon. Marshall McDonald, U. S. Commissioner of Fish and Fisheries; of pure native olive oil from Mr. S. S. Goodrich, of the Quito Olive and Vine Farm; of the pure seed oils from the late F. S. Pease, manufacturer of pure oils, Buffalo, New York.

The correspondence of the Division receives careful and prompt attention.

Very respectfully,

THOMAS TAYLOR,
Microscopist.

Hon. J. M. RUSK,
Secretary.

THE SILVER TEST FOR ADULTERATIONS OF LARD AND OILS.

HOW TO DETECT FICTITIOUS LARD.

On receiving samples of suspected lards I first heat 2 ounces of each sample in a porcelain evaporating basin over a slow fire until the lard begins to fume, when it is removed and allowed to cool slowly in the same basin in a temperature of about 75° F. If the sample is a composition of stearin and cotton-seed oil it will cool in a few minutes, but if it is pure lard it will require perhaps from three quarters of an hour to an hour to cool. Fats thus treated will yield very fine typical crystals. By means of the microscope, without using chemicals, the crystals of lard may be distinguished from those of oleo, stearin, palmitin, stearic acid, or palmitic acid.

Having obtained satisfactory proof in this direction, I next proceed to my second test, viz, that of the color reactions brought about by treating the samples with a solution of nitrate of silver.

Before making experiments with chemical tests upon "commercial lards" it is obvious that one should be familiar with the results of the same tests upon the individual oils and fats which may enter into their composition. "Commercial lard" is largely made up of stearin and cotton-seed oil. Sometimes there is a trace of pure lard in it, but generally speaking not any. My method of using the nitrate of silver solution in testing commercial lards is based upon experience gained by ascertaining, first, the reactions of the nitrate of silver of various degrees of strength on the pure fats used singly, and secondly, upon combinations of these fats.

How to prepare the silver test.—First, dissolve the nitrate of silver in distilled water to saturation. To 1 fluid ounce of this add 2 fluid ounces of distilled water, and mix well in a perfectly clear stoppered bottle. The test tubes used should be well made, five eighths of an inch in diameter by 6 inches in length. Each tube should be numbered. Into each pour two cubic centimeters of the fat to be tested, made liquid by heat. Secure the contents with a well-fitting cork, and mix quickly while the fat is quite liquid. Remove the cork and heat the silver and fat evenly from end to end of the tube. Bring the silver solution to the boiling point. The vapor of the silver solution retained in the oil should show signs of bursting into steam. Heating and boiling should be accomplished in about one minute and the tube then replaced in the rack to cool.

Oleic acid, marked chemically pure, from Eimer and Ahmend, on being boiled with the silver solution one minute becomes slightly cloudy, as if it contained a solid fat of a light chrome color, and the silver solution becomes highly charged with what appears to be a silver precipitate of a brownish-pink color, whether viewed by transmitted or reflected light. This pinkish colored precipitate of silver has been observed to occur on three occasions with other oils; once with linseed oil, once with poppy seed, and once with peanut oil. I think when it occurs it indicates the presence of free oleic acid. Stearic acid submitted to the same test showed no change of color or precipitate of silver. Palmitic acid gave the same results. Glycerine, a component part of fats, I treated in like manner. Price's glycerine was used, adding a small portion of alcohol simply for the purpose of thinning it, so that if the silver were deoxidized it would readily precipitate. On boiling the solution a silver stain became

apparent at the bottom of the tube. When cool the entire mixture was colored a light slate color, from a slight precipitate of silver.

By direct experiment I find that chemically pure stearin may be boiled in a solution of the nitrate of silver without suffering discoloration, and from the fact that no deposit of metallic silver appears in the silver solution employed it is evident that stearin under this condition does not deoxidize nitrate of silver.

Palmitin, marked chemically pure, treated in the same manner, exhibits properties very much like those of stearin. This fat when cooled presents a pure white color, but I have observed that the silver solution was slightly darkened on boiling. I think probably the sample of palmitin used contained a trace of olein.

Commercial oleo, beef oil, an extract of beef fat, is composed largely of the olein or oil of beef fat. It also contains palmitin, and a very small percentage of stearin. Boiled with the nitrate of silver solution, the *solid fat* of the oil retains its original color, but the *oil proper* causes a slight darkening of the solution.

By these experiments it will appear that neither stearin nor palmitin deoxidizes silver. Should this prove correct, it will appear evident that the pure oil of beef fat decomposes the silver to a very limited extent. If soft commercial stearin, which contains a trace of beef oil proper, is tested in the same way, it will be observed that while the stearin is not affected the beef oil causes a slight precipitation of silver, as in the case of commercial oleo.

Pure and perfectly fresh leaf lard treated as above is not changed in color, neither does it precipitate silver from the diluted solution, but late experiments demonstrate that if pure lard is exposed to the atmosphere of a warm room for several days its chemical properties are somewhat changed, and on testing it with the silver solution not only is the silver solution darkened but the hot lard becomes brown and a dark precipitate of silver is formed.

A sample of the same lard exposed for three days longer, on being tested in the same manner, showed conclusively, on being heated to the boiling point of the silver solution, an increase of brown coloration of the liquid, together with a dark precipitate of silver in the silver solution at the bottom of the tube. On standing for thirty minutes a dark ring of silver precipitate is observed resting on the surface of the silver solution. In connection with these experiments I tested in the same way a sample of pure leaf lard which I had rendered myself in June last. This lard had been continuously exposed to light and air in a temperature of about 75° F. On treating this sample of the lard with the silver solution, silver began to fall quickly in the solution as the temperature increased, until its density had become such that a solid gray mass of silver apparently filled the bottom of the test tube to the depth of half an inch, and the liquid lard had become quite brown in color.

The lard when cold (congealed) has a slight brownish tinge, but on remelting it, it appears quite brown and translucent by reflected light; by transmitted light it appears light brown and translucent.

It will be seen by these experiments with lard and the silver test, that the condition of the lard as regards freshness must be considered, otherwise pure lard that is slightly acid from exposure may be condemned as adulterated, or as being a compound of lard and cotton-seed oil.

In England at the present time, under the silver test, a person may be sent to the penitentiary for selling pure lard, because of the honest

conviction of some experts that lard exhibits no reaction with the silver solution.

SILVER TEST FOR OLIVE OIL.

In the following experiments the olive oil and other oils treated are from sources which I know to be reliable. Samples of our native olive oil were furnished me by Mr. S. S. Goodrich, proprietor of the Quito Olive and Vine Farm, California, and by the Messrs. Wright Brothers, Riverside, California. The seed oils were obtained from the late F. S. Pease, manufacturer of fats and oils, Buffalo, New York.

I found early in my investigation that owing to a difference in the physical properties of the oils, all the spectrum colors might be produced by regulating the strength of the silver solution, subjecting the mixtures to a uniform heat; the color-reactions of certain oils will be observed more quickly than others. Most of the oils when boiled with a saturated solution of the nitrate of silver for one minute will precipitate a portion of silver, some more some less in amount, and in some cases the bright silver is deposited on the wall of the tube opposing the column of oil. But pure olive oil treated with a saturated solution of the nitrate of silver is not as satisfactory in behavior as when a diluted solution is used. I have found that by diluting the saturated solution 50 per cent with distilled water I obtained better results, but that by a still weaker solution the results are still more satisfactory; greater divergence of color and stronger tints are obtained in all the oils.

The solution I have used in these experiments consists of an ounce of the concentrated solution to 2 ounces of distilled water well mixed in a stoppered bottle. With this solution I proceed as follows: Test-tubes five eighths of an inch in diameter and 6 inches in length are arranged in a suitable rack, and numbered from 1 to 7, respectively. No. 1, pure olive oil; No. 2, pure lard oil; No. 3, cotton-seed oil; 4, poppy-seed oil; 5, peanut oil; 6, oil of sesame (benne oil); 7, colza oil. A well-fitting cork is provided for each tube, and a spirit lamp placed conveniently. Into each tube I pour 2 cubic centimeters of the silver solution, following it with 4 cubic centimeters of the oil in the order given above. Each tube is tightly stoppered to prevent staining the fingers and is well shaken, so that the solution will be intimately mixed with the oil. The corks are then removed and the tubes replaced in the rack. At this stage it will be observed that the oils appear to have changed color, becoming more or less cloudy and of different tints or shades of color. This change of color and cloudiness arises from the precipitation of natural fats of the oils, which finally fall and rest on the surface of the silver solution. I then boil each mixture, holding the tube over the flame of the lamp, moving it backwards and forwards until the clear silver solution boils. With an adequate flame the time required for this process should not exceed one minute for each sample. Observe changes of color as they occur.

No. 1. Pure olive oil. Natural color a greenish yellow, with a nutty flavor. The clear silver solution on boiling for one minute exhibits a whitish bloom owing to a slight reduction of silver, but soon clears. If properly heated the oil will change to a well-defined light sienna color, translucent owing to the precipitate of fat, but with no deposit of silver. At this stage of the experiment sometimes, from overheating, a shade of silver may be observed on the tube wall opposing the oil column near the surface of the silver solution. In this case the oil is much darker. This observation is important from what follows on heating the other oils.

No. 2. Pure lard oil. Natural color light straw. The silver solution is slightly darkened on boiling, and a slight deposit of silver falls to the bottom of the test tube. In the course of several days the oil appears lighter in color and translucent, owing to the deposit of fat.

No. 3. Cotton-seed oil (unbleached). Natural color deep yellow. The silver solution is slightly darkened, afterwards clearing. The color of the oil changes to a reddish yellow, and the tube wall on cooling is generally spotted with silver. Rancid lard oil yields more of the silver precipitate than the fresh oil.

No. 4. Poppy-seed oil. Natural color deep yellow. The silver solution becomes reddish brown changing to black. This, later, coagulates and becomes jet-black, rising to the surface of the silver solution. This feature is constant. The oil above is cloudy from the precipitate of natural fat, and changed in color to a greenish yellow, but after standing several days the dark fat precipitates and the oil becomes clear. A very slight deposit of silver is observed at the bottom of the tube, after twenty-four hours.

No. 5. Peanut oil. Natural color light straw. The silver solution is slightly darkened, with a light deposit of silver at the bottom of the tube. Bright specks of silver appear on the tube walls opposing the silver solution. A light orange-colored congealed fat soon deposits on the surface of the silver solution. The oil becomes perfectly clear and of a pale sienna color. After several days the precipitated fat changes in color from orange to bright chrome yellow and a very heavy bright deposit of silver falls to the bottom of the test tube.

No. 6. Oil of sesame (benne). Natural color very light greenish yellow. The silver solution is slightly darkened. Later it clears up colorless. Slight deposit of silver. The oil changes to a light straw-color on precipitation of its fat, which rests on the silver solution.*

No. 7. Colza oil. Natural color light greenish yellow. Heated with the silver solution, colza oil becomes saffron color viewed by transmitted or reflected light; after several days changes to a very dark amber viewed by transmitted light. The silver solution exhibits a slightly yellow color on heating, but clears depositing silver lightly at the bottom of the test-tube. On standing for thirty-six hours silver specks are seen on the tube wall opposing the oil column.

Having acquired a knowledge of the properties of the individual oils, as above, I proceed to combine them respectively and individually with the pure olive oil and silver solution and note results, using the same proportions of each mixed oil with 2 cubic centimeters of the silver solution as in the experiments with the individual oils, observing the same method of treatment:

No. 1. Pure olive oil and pure lard oil, 4 cubic centimeters of each, to which is added 2 cubic centimeters of the silver solution.

No silver is thrown down in the silver solution during the heating process, but after standing several days a very light silver precipitate is frequently observed on the tube wall opposing the oil. Color a light straw, lighter than that of either oil when treated singly

No. 2. Olive and cotton-seed oil. On boiling olive and cotton-seed oil a very slight dark shade sometimes occurs in the silver solution which clears on cooling. No silver is thrown down to the bottom of the test-tube if the cotton-seed oil is perfectly fresh. On standing several days a narrow band of orange-colored fat appears rest-

* Olive and sesame oils may be tested to profit by either the nitric or the sulphuric acid tests given in my last annual report to the Secretary of Agriculture, volume 1889, page 197.

"Test A, 55 parts sulphuric acid chemically pure, combined with 45 parts distilled water, by measure. Specific gravity 1.575, temperature 71.6° F., 22° C.

"Test B, 55 parts sulphuric acid chemically pure, combined with 30 parts distilled water, by measure. Specific gravity 1.648, temperature 71.1° F., 22° C."

If the oil of sesame is present in olive oil, it may be detected by either test A or B. By the former as small an amount as 5 per cent will be indicated. By test B a well-defined violet tinge is seen in the lower layer of the tube, and above this, about midway of the tube, a dark band characteristic of the oil of sesame is observed. The color reactions of the oil of sesame treated with test A are different from the color reactions with test B (see Plate 4, Figs. 3, 4). See also in same report nitric acid test for olive oil, which distinguishes it from all other oils, lard oil excepted.

ing on the silver solution. The oil appears a clear light straw-color by transmitted light, dark brown color by reflected light after the lapse of several days. The tube wall is spotted with the silver deposit.

No. 3. Olive and poppy-seed oil. Light deposit of silver at the bottom of the tube. Light brown deposit of natural fat with particles of the fat light brown in color dusting the wall of the tube. No deposit of silver is observed after standing for several days. Color of the oil, light yellow by reflected light and the same by transmitted light.

No. 4. Olive and peanut oil. A heavier deposit of silver appears in the silver solution, but none is seen in the oil column. The oil appears translucent from precipitation of natural fat and becomes an orange color. After eight days the color changed to a chrome yellow.

No. 5. Olive and sesame oil. A light deposit of silver on the tube wall opposing the oil column, the silver solution is clear. The color of the oil by reflected light is a dark amber, viewed by transmitted light it appears a lighter shade of same color. There is a heavy deposit of natural fat brick-dust-red in color, the lower stratum of which appears a light brown.

No. 6. Olive and colza oil. This mixture when combined before heating appears translucent and a very light straw-color, clearing at the surface of the oil quickly, the fats falling to the bottom of the oil column. On boiling, the oil becomes a deep shade of ochre. No bright silver precipitate is observed at this stage.

In the absence of colored illustrations it is difficult to convey an accurate knowledge of the color-changes herein described. I therefore recommend strongly that duplicates of all experiments be made, as strict uniformity of color can not always be attained, and in duplicating one will soon perceive, owing to slight difference in results, that a sample may have been overheated while another has been underheated.

In a series of experiments made with a variety of oils using the *saturated solution* of nitrate of silver precipitates of silver were obtained in each case. After several weeks' exposure to light, the amount of allotropic silver was found to be much increased. (See plates 7, 8, 9, and 10.)

MUSHROOMS OF THE UNITED STATES.

Since the publication of my first report on the edible mushrooms of the United States, which appeared originally in the annual volume of this Department for the year 1875, there has been a continuous demand for information on this subject, applications for copies of that paper having been received from nearly every State of the Union. My present report contains descriptions and illustrations of eight additional species of edible mushrooms common to the United States, together with simple and improved methods of mushroom culture and some recipes for preparing mushrooms for the table which may be welcome in localities where as yet this savory, nutritious, and abundant comestible has not been utilized. Twelve of the poisonous varieties are also described and their distinguishing characteristics illustrated.

Before selecting mushrooms from field or forest inexperienced persons would do well to consider first carefully the descriptions of the characteristics of edible and poisonous varieties given in the respective plates. The taste and odor of a mushroom is quite significant and it would be well to reject all mushrooms found growing in filthy places. The colors of mushrooms should also be carefully observed. A red-topped mushroom with yellow or tan-colored gills, white or pink stalk, is edible, while a red-topped mushroom with white gills and a white stem, is poisonous. The common puff-ball for table use

EIGHT EDIBLE MUSHROOMS COMMON TO THE UNITED STATES.
SECOND SERIES.

TWELVE POISONOUS MUSHROOMS.

should have white flesh, a firm texture, and should be free from insects. The small warty puff-ball is not used; it has a bad odor. Avoid mushrooms which on bruising the gills yield a *white milk; they are all poisonous.*

There is a yellow mushroom known to botanists as *Lactarius deliciosus*, which yields an orange milk when bruised. It is of a bright, golden-yellow color, having an odor that has been compared to that of apricots; is found plentifully in some of the States but is practically unknown to the public. For a further description of it see my first paper, "Twelve Edible Mushrooms of the United States," Plate I, Fig. 1.

A class of mushrooms known as *Boleti* supply many edible species. Select none for table use but such as are found growing. In the edible varieties the flesh remains white when broken, but turns quickly a deep blue if poisonous. The Boleti have pores instead of gills. Avoid any of the Boleti having bright red tops. The edible have generally a shaded brown top; the pores underneath may be green or yellow. For culinary purposes remove the spore tubes and stalks. The outer skin of the top is peeled off, when they may be dried on strings, like cut apples, and kept for use. Although this class is not generally regarded as edible in the United States, "it is sold commonly in all stores where beans, barley, and such food substances are kept on sale in Germany." (Cook.)

EIGHT EDIBLE MUSHROOMS OF THE UNITED STATES.

[Description of Plate I.]

FIG. 1. "Plum" mushroom (*Agaricus prunulus*). Of this species Worthington G. Smith gives the following description: "The pure pink gills running considerably down the ringless stem, and the fresh, fragrant smell of meal, at once distinguish this species from all others. The solid stem and very fleshy top are white or some shade of very pale gray. The flesh is firm, juicy, and full of flavor; and broiled or stewed it is a most delicious morsel." It grows in and near damp woods. Its top will measure from an inch and a half to 6 inches across.

FIG. 2. "Variable" mushroom (*Russula heterophylla*). This species is known by its sweet, nutty taste, and is very common in the woods. Its gills are white, and sometimes branched; flesh, white; stem, solid, white, and ringless; top, firm, variable in color, as its name indicates; the thin, viscid covering of the pileus is commonly subdued green, but at one time approaches greenish yellow or lilac, and at another grey or obscure purple. The top is at first convex, becoming concave. It is excellent baked with salt, pepper, and butter, between two dishes.

FIG. 3. "Scaly" mushroom or "Parasol Agaric" (*Agaricus procerus*). This, which is, according to W. Robinson, the "parasol" agaric, is by some thought superior to the common or "Meadow" mushroom. Robinson says: "Whenever an agaric on a long stalk enlarged at the base presents a dry cuticle more or less scaly a darker colored umbonated top, movable ring, and white gills it must be *Agaricus procerus*, the parasol agaric, and it may be gathered and eaten without fear. When the whitish flesh of this species is bruised it shows a light reddish color." It grows in pastures and woods and is known by its long bulbous spotted stem, by the ring that will slip up and down, by the very scaly top, and the gills far removed from the stalk at its insertion. Diameter of top 5 to 8 inches.

FIG. 4. "Honey-colored" mushroom (*Armillaria mellea*). This very common species is not highly esteemed in some countries where other and better sorts can be had. It is acrid when raw. Pileus fleshy, color pale rufous, more or less shaded with yellow. It grows in tufts on old stumps. Stem elastic, gills pallid and running down the stem.

FIG. 5. *Lepiota cepæstipes*, var. *cretaceus*. This very delicate and beautiful agaric is found on tan and leaves in hot houses. The specimens here delineated I found in one of the hothouses of the Department gardens. Its color is very pure white throughout. Both stem and pileus are covered as seen in the drawing, with small chalky tufts. "This species," says Berkeley "is probably of exotic origin, as it never grows in the open air." It is met with in the hothouses of Europe. (Peck).

FIG. 6. "Horse" mushroom. (*Agaricus arvensis*). This species, found in fields and pastures in the autumn is when young and fresh most desirable eating. The top in good specimens is snowy white. Gills pinkish, turning to brown, ultimately becoming brownish black. It has a big ragged floccose ring and pithy stem inclined to be hollow. As soon as broken or bruised this mushroom turns a brownish yellow. Its flesh is firm and delicious and yields an abundant gravy. Diameter of pileus 6 to 24 inches.

FIG. 7. *Cortinarius cærulescens*. Pileus fleshy, a very beautiful blue color. Gills a pure blue. Stem also blue with margined bulb. A cobweb-like filament frequently extends from the base of the stem to the margin of the pileus. Skin is viscid when moist. Grows on stumps.

FIG. 8. "Oyster" mushroom (*Agaricus ostreatus*). Found on dead tree trunks in the autumn. Top cinereous in color. Gills white, stem eccentric or altogether wanting. It usually grows in masses one above another. Worthington G. Smith says of this species: "A dish of them stewed before a very hot fire has proved as enjoyable and nourishing as half a pound of fresh meat." *A. ostreatus* may be dressed in any of the usual ways, but is better cooked over a slow fire.

MUSHROOM CULTURE.

The French often cultivate mushrooms in cellars as well as in caves. The cellar should be warm and dry, as dark as possible, and exposed to no draughts. Only two species thus far have been successfully cultivated, viz, *Agaricus campestris*, and an allied species, *A. arvensis*. Plates III, IV, and V illustrate several modes of cultivation.

FIG. 1, PLATE III, represents a pyramidal-shaped mushroom bed made on the top of cask bottoms, which should be at least 2 feet 6 inches in diameter. They are built in the shape of an old-fashioned sugar loaf about 3 feet in height; the pieces of spawn placed 1½ inches deep and 16 inches apart.

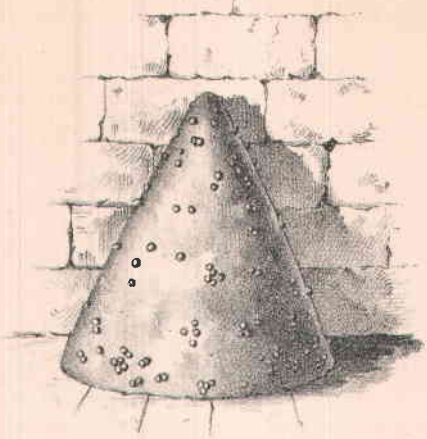
FIG. 2, PLATE III, represents mushroom culture in barrels sawed into two pieces crosswise, each forming a tub. Holes are made in the bottom of each tub and a thin layer of good soil is spread over them inside. They are then filled with good well-prepared stable manure as in the case of ordinary mushroom beds. When the tub is half full with material well pressed down six or seven good pieces of spawn are placed on the surface and the remainder of the tub is piled up with manure well pressed down, the operation being completed by giving to the heap the form of a dome. The boxes or tubs should then be placed in a cellar, thus avoiding the objectionable feature of the steam from the manure.

FIG. 3, PLATE III. Mushroom bed upon a shelf in a stable. Strong bars of iron are driven into the walls, upon which are placed shelves of the proper size covered with earth, upon which is formed a bed that is treated exactly as those made upon the ground. These beds are just as productive as any other kinds.

Mushrooms may be grown in all kinds of greenhouses, "stoves," pits, and frames. Some of the best crops, according to Robinson, have been raised in cold greenhouses, almost too ruinous to grow anything else. Mushrooms may be grown in the open air in gardens. The Paris growers never attempt their culture in summer. The London gardeners very rarely do so. It is in winter that their cultivation is carried on in full vigor in the open air. Abundant crops are grown in the open air by the market gardeners of London and Paris. From their beds mushrooms are gathered in quantities in midwinter as well as in autumn.

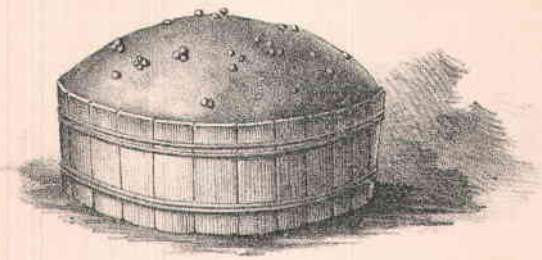
FIG. 4, PLATE IV, represents the uncovered end of a mushroom bed in a Paris market garden. The horse manure is collected for a month or six weeks before the beds are made. All rubbish, chips, etc., are carefully taken out and the heaps are raised generally 2 feet thick and pressed down with the fork. When this is done the bed is well stamped and thoroughly watered and finally stamped again. It is left in this state for eight or ten days, by which time it has begun to ferment, after which the bed should be well turned over and remade on the same place, placing the manure that was at the sides in the center of the heap on turning and remaking. The mass is then left ten days more, at the end of which time the manure is about in proper condition for making the beds that are to bear the mushrooms. Little ridge-shaped beds about 26 inches wide and the same in height are then formed in parallel lines

FIG 1.



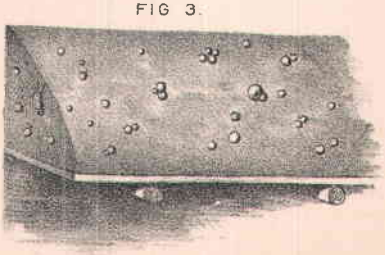
PYRAMIDAL MUSHROOM BED ON FLOOR OF CELLAR.

FIG 2



MUSHROOMS GROWN IN BOTTOM OF OLD CASK.

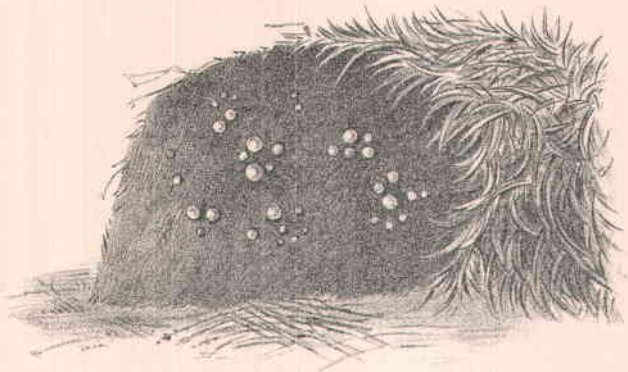
FIG 3.



MUSHROOM BED ON RUDE SHELF AGAINST WALL OF CELLAR.

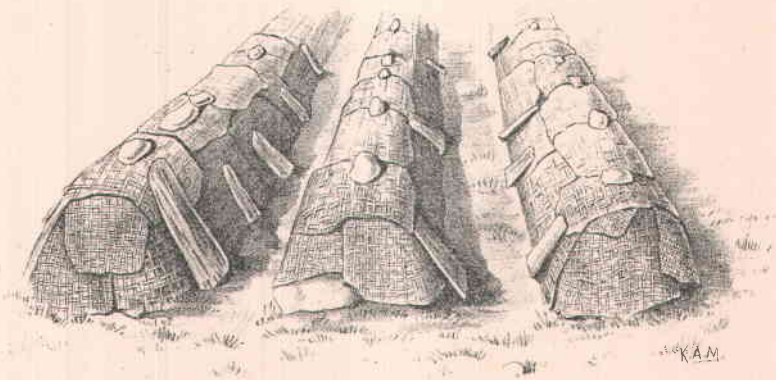
Strobel Lith. & Roch. N.Y.

FIG 4



UNCOVERED END OF MUSHROOM-BED IN PARIS MARKET-GARDEN

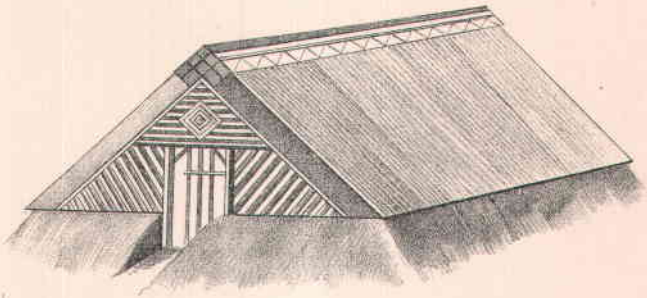
FIG 5



MUSHROOM-BEDS IN MARKET-GARDENS, KENSINGTON, ENGLAND

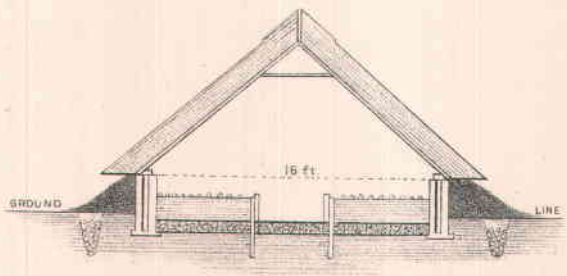
Strobel Lith Co Troy, N.Y.

FIG 6



VIEW OF UNHEATED MUSHROOM-HOUSE

FIG. 7



SECTION OF PRECEDING FIGURE

at a distance of 20 inches apart and of any desired length. (See Fig. 5, Plate 4.) The beds once made of a firm close-fitting texture, the manure soon begins to warm again, but does not become unwholesomely hot for the spread of the spawn. The spawn is inserted generally within a few inches of the base, about 13 inches apart in the line of course, having ascertained beforehand that the heat is genial and suitable. The pieces of spawn used are about the size of three fingers and then the manure is closed over and pressed firmly around. This done the beds are covered with about 6 inches of clear litter. If after the lapse of ten or twelve days the white filaments are seen spreading in the bed the cultivator knows that the spawn is good; if not, the spawn is rotting and must be removed and replaced with better. When the spawn is seen spreading well through the beds, the bed should be covered with fresh, sweet, rich soil of the garden and applied equally and firmly with a shovel to the depth of about an inch or so. A covering of abundance of litter or old mats is put on after the beds are earthed, and kept in place by means of tiles, bricks, old boards, or any such material for protection. The beds will soon be in full bearing and it is thought better to examine and gather from them every second day or even every day if there are many beds. Occasional watering is necessary in a dry season. The beds are spawned at a temperature of about 80° F.

FIGS. 6 and 7, PLATE V, represents a mushroom house and sections designed with a view to growing mushrooms during the greater part of the year without the aid of artificial heat. It is constructed, as will be seen, in such a way as not to be affected by changes of the external temperature. The walls are hollow and banked round with the soil excavated from the interior. The roof is thatched with reeds and the ends stud-work, lined inside with boards and outside with split larch poles, the cavity to be filled with sawdust or cut straw; a small diamond-shaped ventilator, hung on pivots, to be fixed in each end. The floor may be of concrete or burnt clay, well rammed, and the beds are retained in their places by boards nailed to good oak posts. Care should be taken to put efficient drains so that no stagnant damp may exist about the building.

As the Department of Agriculture has had frequent inquiries as to mushroom spawn and how and where to obtain it, the following, taken from Robinson on Mushroom Culture, is inserted for the benefit of those whom it may concern:

Generally, the spawn is supposed to be analogous to *seed*. It is really what may be termed the vegetation of the plant, or something analogous to roots, stems, and leaves of ordinary plants, the stem, head, and gills of the mushroom being in fact the fructification. Spawn is found in a natural state in half decomposed manure heaps, in places where horse droppings have accumulated and been kept dry, and rarely or never in very moist or saturated materials. This natural spawn is the best, and should be used wherever it can be found. Divide the white spawn into pieces a few inches square, say, an inch or more thick. They will, of course, break up irregularly, but all should be used, whether of the size of a bean or nearly that of the open hand. In most places where horses are kept opportunities of finding this spawn occur. Its white, filamentous, and downy threads have the odor of mushrooms, and the spawn is therefore very easily recognized. It need not be used when found, but may be dried and kept in a dry place for years; has been known to keep as long as fourteen years. To preserve spawn found in a natural state nothing more is required than to take up carefully the parts of the manure in which it is found, not breaking them up more than may be necessary, and placing the pieces, of all sizes, loosely in rough shallow hampers. Place these in some airy loft or shed till thoroughly dry, and afterwards pack in rough boxes till wanted for use.

ARTIFICIAL MUSHROOM SPAWN.

This spawn is made from horse droppings and some cow dung and road scrapings beaten up into a mortar-like consistency in a shed and then formed into bricks slightly differing in shape with different makers but usually thinner and wider than common building bricks. The following proportions are about the best: (1) Horse droppings the chief part; one fourth cow dung; remainder loam. (2) Fresh horse droppings mixed with short litter for the greater part; cow dung one third; and the rest mold or loam. (3) Horse dung, cow dung, and loam in equal parts. These bricks are placed

in some dry airy place and when half dry a little bit of spawn about as big as a hazel nut is placed in the centre of each, or sometimes when the bricks are as wide as long a particle is put near each corner just inserted below the surface and plastered over with the material of the brick. When nearly dry the bricks are placed in a hotbed about a foot thick in a shed or dry place. The bricks are piled openly and loosely and covered with litter so that the heat may circulate evenly among them, not above 60° F. If the temperature should exceed this it may be reduced by removing the covering of the litter. The bricks are frequently examined during the process and when the spawn has been found to spread throughout the brick like a fine white mold it is removed and allowed to dry for future use in a dark place. If allowed to go further than the fine white mold stage and form threads and tubercles in the bricks it has attained a higher degree of development than is consistent with preserving its vegetative powers, and therefore it should be removed from the drying bed in the fine mold stage.

French mushroom spawn differs from our own in not being in the form of bricks or solid lumps, but in rather light masses, scarcely half decomposed, comparatively loose, dry litter. This spawn is obtained by preparing a little bed, as if for mushrooms, in the ordinary way, and spawning it with morsels of virgin spawn, if obtainable. When the spawn has spread through it the bed is broken up and used for spawning beds in the caves or dried and preserved for sale. It is sold in small boxes, and is fit for insertion when pulled in rather thin pieces about half the size of the open hand. In separating it, it divides into many small pieces, every particle of which should be used. The small particles should be strewn broadcast over the bed after the larger pieces have been inserted. There is no necessity for purchasing artificial spawn at all where mushrooms are regularly grown. Nor is there in any case, except at the commencement or to guard against one's own spawn proving bad. To secure good spawn we have only to do as the French growers do, take a portion of a bed where it is thoroughly permeated by the spawn and before it begins to bear and preserve it for future use.

The following methods of cooking mushrooms may prove useful:

Broiled Procerus.—Remove the scales and stalks from the agarics and boil lightly over a clear fire on both sides for a few minutes; arrange them on a dish over freshly made well buttered toast; sprinkle with pepper and salt and put a small piece of butter on each; set before a brisk fire to melt the butter, and serve up quickly. Bacon toasted over broiled mushrooms improves the flavor and saves the butter.

Agarics delicately stewed.—Remove the stalks and scales from young, half-grown agarics and throw each one as you do so into a basin of fresh water slightly acidulated with the juice of a lemon or a little good vinegar. When all are prepared remove them from the water and put them in a stewpan with a very small piece of fresh butter. Sprinkle white pepper and salt and add a little lemon juice; cover up closely and stew for half an hour; then add a spoonful of flour with sufficient cream, or cream and milk, till the whole has the thickness of cream. Season to taste and stew again until the agarics are perfectly tender. Remove all the butter from the surface and serve in a hot dish garnished with slices of lemon. A little mace or nutmeg or catsup may be added, but some think that spice spoils the flavor.

Cottager's Procerus pie.—Cut fresh agarics in small pieces and cover the bottom of a pie dish. Pepper, salt, and place them on small shreds of fresh bacon, then put in a layer of mashed potatoes, and so fill the dish layer by layer with a cover of mashed potatoes for the crust. Bake well for half an hour and brown before a quick fire.

A la Provençale.—Steep for two hours in some salt, pepper, and a little garlic, then toss them in a small stewpan over a brisk fire with parsley chopped and a little lemon juice. (Dr. Badham.)

Agaric ketchup.—Place agarics of as large a size as you can procure, but which are not worm-eaten, layer by layer in a deep pan, sprinkling each layer as it is put in with a little salt. Then next day stir them well several times so as to mash and extract their juice. On the third day strain off the liquor, measure, and boil for ten minutes, and then to every pint of liquor add half an ounce of black pepper, a quarter of an ounce of bruised ginger root, a blade of mace, a clove or two, and a teaspoonful of mustard seed. Boil again for half an hour; put in two or three bay leaves and set aside till quite cold. Pass through a strainer, and bottle; cork well and dip the ends in resin. A very little Chili vinegar is an improvement, and some add a glass of port wine or a glass of strong ale to every bottle. Care should be taken that the spice is not so abundant as to overpower the true flavor of the agaric. A careful cook will keep back a little of the simple boiled liquor to guard against this danger; a good one will always avoid it.

To stew mushrooms.—Trim and rub clean half a pint of large button mushrooms. Put into a stewpan 2 ounces of butter; shake it over a fire until thoroughly melted; put in the mushrooms, a teaspoonful of salt, half as much pepper, and a blade of mace pounded; stew till the mushrooms are tender, then serve on a hot dish. This is usually a breakfast dish.

Mushrooms a la creme.—Trim and rub half a pint of button mushrooms; dissolve 2 ounces of butter rolled in flour in a stewpan; put in the mushrooms, a bunch of parsley, a teaspoonful of salt, half a teaspoonful each of white pepper and of powdered sugar, shake the pan for ten minutes, then beat up the yolks of two eggs with two tablespoonfuls of cream, and add by degrees to the mushrooms; in two or three minutes you can serve them in sauce.

Mushrooms on toast.—Put a pint of mushrooms into a stewpan with 2 ounces of butter rolled in flour; add a teaspoonful of salt, half a teaspoonful of white pepper, a blade of powdered mace, and half a teaspoonful of grated lemon; stew till the butter is all absorbed; then serve on toast, or as soon as the mushrooms are tender.

To pot mushrooms.—The small open mushrooms suit best for potting. Trim and rub them; put into a stew pan a quart of mushrooms, 3 ounces of butter, two teaspoonfuls of salt, and half a teaspoonful of Cayenne and mace mixed, and stew for ten or fifteen minutes or till the mushrooms are tender; take them carefully out and drain them perfectly on a sloping dish, and when cold press them into small pots and pour clarified butter over them, in which state they will keep for a week or two. Writing paper over the butter, and over that melted suet will effectually preserve them for weeks if in a dry, cool place.

To pickle mushrooms.—Select a number of small sound pasture mushrooms as nearly alike in size as possible. Throw them for a few minutes into cold water, then drain them, cut off the stalks and gently rub off the outer skin with a moist flannel dipped in salt;

then boil the vinegar, adding to each quart 2 ounces of salt, half a nutmeg grated, a drachm of mace, and an ounce of white peppercorns. Put the mushrooms into the vinegar for ten minutes over the fire, then pour the whole into small jars, taking care that the spices are equally divided; let them stand a day; then cover them.

Baked mushrooms.—Peel the tops of twenty mushrooms; cut off a portion of the stalks and wipe them carefully with a piece of flannel dipped in salt. Lay the mushrooms in a tin dish, put a small piece of butter on the top of each, and season with pepper and salt. Set the dish in the oven and bake them from twenty minutes to half an hour. When done arrange them high in the center of a very hot dish, pour the sauce round them, and serve quickly and as hot as you possibly can.

Mushrooms with bacon.—Take some full-grown mushrooms and having cleaned them procure a few rashers of nice streaky bacon and fry it in the usual manner. When nearly done add a dozen or so of mushrooms and fry them slowly until they are cooked. In this process they will absorb all the fat of the bacon, and with the addition of a little salt and pepper will form a most appetizing breakfast relish.

Mushrooms en ragout.—Put into a stew pan a little "stock," a small quantity of vinegar, parsley, and green onions chopped up, salt and spices. When this is about to boil, the mushrooms being cleaned, put them in. When done remove them from the fire and thicken with yolks of eggs.

Extract from the letter of a correspondent in Virginia:

* * * I learned so much from your "Twelve Edible Mushrooms" that I wish to express my gratitude for the book and for the clear and distinct instructions you have put in it. I brought my little book down here this fall where people knew of only one edible mushroom. By your aid we discovered others, especially the Giant Puff-ball, which we gathered in great quantities and prepared in more than one fashion for the table, making an excellent addition to the somewhat limited bill of fare found in a country district, If you can spare a few more copies of your pamphlet I should like to give them to some of my friends to whom I think they would prove eminently useful.

TWELVE POISONOUS MUSHROOMS

[Description of Plate II.]

FIG. 1. "Red-juice" Mushroom (*Hygrophorus conicus*). This species is common in pastures and roadsides. It has a strong and unpleasant odor; flesh, juicy; color of the top, crimson or a deep orange; taste, bitter; stem, hollow. It is found in groups on old tree stumps.

FIG. 2. "Emetic" Mushroom (*Russula emetica*). This dangerous species has a bright scarlet or rose-colored top, sometimes shaded with purple. The skin is readily peeled off exposing the flesh which is white. It is very acrid to the taste.

FIG. 3. "Verdigris" Mushroom (*Agaricus æruginosus*). Pileus fleshy, convexoplane, covered with green mucus; stem, hollow and scaly, tinged with blue; gills, brown tinged with purple. This mushroom quickly decays. Top is about 3 inches across.

FIG. 4. "Satanical" tube Mushroom (*Boletus satanas*). By far the most splendid of all the Boleti. Top nearly white, very fleshy and a little viscid. Stem firm, exquisitely reticulated. The under surface of the pileus is bright crimson. When bruised or broken the inner fleshy substance becomes a deep blue. As its name indicates this belongs to the class of tube or pore-bearing fungi. The pores are upon the under surface of the pileus and take the place of the gills or lamellæ of the Agaricini group.

FIG. 5. "Trellised" Clathrus (*Clathrus cancellatus*). This is a poisonous mushroom of great beauty and variety. The fœtor exhaled from it is most repulsive. In the young plant, however, the bad odor is not so strong, or may be altogether wanting.

FIG. 6. "Spring" Mushroom (*Agaricus* (*Amanita*) *vernus*). This agaric is found in

the woods in the spring, and is white in all its parts. It is supposed to be very poisonous.

FIG. 7. "Fiery" tube Mushroom (*Boletus piperatus*). One of the smaller Boleti. Taste, highly acrid: grows in woods; it is probably dangerous; never attains a large size.

FIG. 8. "Fly" Mushroom (*Agaricus* (*Amanita*) *muscarius*). This species, allied to the perfectly wholesome red-fleshed mushroom, *Amanita rubescens*, is a bright yellow just beneath the skin, the rest is white. It is usually a bright scarlet on top, sometimes a deep yellow or orange. Few species can exceed it in beauty. It grows in some places in such profusion as to make the very ground scarlet. Found in birch and pine woods.

FIG. 9. "Ruddy-Milk" Mushroom (*Lactarius rufus*). Pileus fleshy, umbonate, at length funnel shaped, dry, zoneless, dark rufous; stem stuffed, rufous; gills crowded, ocherous and rufous. On bruising the gills a white milk exudes which is extremely acrid and corrosive, a distinguishing mark.

FIG. 10. "Fiery Milk" Mushroom (*Lactarius piperatus*). So called from the powerfully acrid milk which it contains, white and abundant. When the milk is placed on the lips or tongue it produces the sensation of scalding or searing with a hot iron. Color white, inclining to cream; flesh firm and solid. Found in dry woods.

FIG. 11. "Bitter" Tube Mushroom (*Boletus felleus*). This mushroom is rare. Pileus is soft, smooth, brown, inclining to reddish grey; stem solid above, attenuated, reticulated; tubes or pores angular, flesh color, as well as the fleshy substance of the pileus when broken. The flesh is very bitter.

FIG. 12. "Fetid Wood-Witch" (*Phallus impudicus*). Had not this species been known to have been eaten it would be hardly necessary to have referred to it. Flies appear to relish it and devour it greedily. It is offensive and dangerous.

BUTTER AND FATS.

ORIGINAL MICROSCOPIC INVESTIGATIONS.

In my early microscopic observations relating to butter and other fats I recommended that, in order to procure highly crystallized fats suitable for microscopic test objects, each fat should be heated to a temperature of 212° F., for one minute, strained to remove tissue, etc., and allowed to cool slowly.

I now find that the fat should be heated, say over the flame of a spirit lamp in a porcelain basin, until it begins to fume, no more, no less, and allowed to cool slowly in the same vessel in which it is melted. Not less than 2 ounces of fat should be melted for each experiment. Hard fats, such as beef fat, in order to obtain well defined crystallization, should be treated as follows: Melt in a porcelain basin 2 ounces of pure fresh beef fat free from tissue, heat to the fuming point; remove from the flame at once, allow it to cool slowly until it becomes semisolid; at this juncture add to it 1 ounce of sweet oil and mix; then allow it to cool slowly in a temperature of about 75° F.

If this process is strictly followed larger and better defined groups of crystals common to beef fat will be obtained than are produced by my original method.

PLATE VI represents the general characteristics of the crystalline groupings of "butter and fats" when subjected to the above treatment. For the sake of convenience the different figures are separated by lines defining small squares on the plate.

FIG. 1. Pure lard crystals viewed by plain light. Their arrangement is that of an aggregation of needle-like crystals proceeding from a common center.

FIG. 2. The same viewed with polarized light, sometimes faintly showing a black cross.

FIG. 3. Oleo crystals viewed by plain light. These are aggregations of branched crystals, color faint, requiring high powers, say × 500, to discern their delicate tracery, which closely resembles the crystalline arrangement of butter by plain light.

FIG. 4. The same object viewed by polarized light. The branchings are not as visible and the black cross is reflected. Such groupings average about .003 of an inch in diameter.

FIG. 5. A group of stearin crystals embedded in palmitin, as seen by polarized light. This fairly represents the crystalline arrangement of commercial stearin. The crystals of stearin appear vividly white under polarized light.

FIG. 6 represents the same group of crystals by plain light.

FIG. 7 represents a mixture of lard and stearin—50 per cent of each—by plain light.

FIG. 8. The same compound by polarized light.

FIG. 9 represents a compound of oleo and stearin—50 per cent of each—by plain light.

FIG. 10. Oleo and stearin by polarized light. The large, central, well-defined branchings represent the stearin. They appear very brilliant in contrast with the translucent mass of palmitin in which they are embedded. In this case the black cross is always wanting. The small globose bodies at the right-hand lower corner of the field are the usual forms of oleo crystallization viewed by polarized light.

FIG. 11. Compound of stearin and butter—50 per cent of each—by plain light. The central figure represents the stearin poorly.

FIG. 12. The same by polarized light. In this case the branchings of the stearin are very readily observed by polarized light, even with low powers. The stearin largely occupies the field, embedded in the palmitin. In the lower right-hand corner a small mass of crystallized butter is represented which has crystallized apart from the stearin.

FIG. 13. Compound of lard and butter. This combination consists mostly of palmitin, the principal fat of lard, and exhibits delicately branched crystals common to butter, viewed by plain light.

FIG. 14. Same compound viewed by polarized light. A faint black cross is observed. Frequently in such cases a bright rosette-like crystal, or rather aggregation of crystals, is seen, which I consider consists of stearin. With regard to the crystallization of stearin, so as to obtain uniform results, nothing is more simple. I have experimented with the stearin of lard, cotton-seed oil, beef and mutton tallow. The stearine crystal under the microscope with polarized light has distinctive characteristics, whether seen as mere specks or as branching forms. Its brilliancy exceeds that of all other fats under polarized light.

FIG. 15. Butter crystals by plain light.

FIG. 16. Butter crystals by polarized light.

FIG. 17. Butter crystals showing the rosette-like form in center, which I consider represents the natural stearin of butter which has crystallized apart from the palmitin of the butter.

FIG. 18 represents a crystallization of butter which I have frequently met with in butter that has been exposed previously to high atmospheric temperatures; but if such a sample is again heated to the fuming point, as already described, then slowly cooled, and viewed with polarized light, the globose forms will again appear as in Fig. 16, changing in several days to those of Fig. 17, and again changing to those represented by Fig. 18. Ultimately they take the forms represented in Figs. 22, 23, 24, 25, 26, 27, 28, 29, and 30.

FIG. 19. Butter and its stearin represented. Stearin of pure butter is obtained by compression, as follows: Place, say, 2 ounces of pure, fresh butter upon several sheets of thick bibulous paper. After several days, most of the oil will be absorbed, remove the butter with a pallet knife and press it between several folds of absorbent paper by means of a common letter press, thus removing the remaining oil and some of the palmitin. Place the solid mass thus obtained in a porcelain capsule over the flame of a spirit lamp and bring it to the fuming point. Then remove it from the fire and strain out the casein, adding, when cooled to a semifluid condition, about one third of its weight in sweet oil. When quite cool examine a portion under the microscope with polarized light, using powers of × 100, turning the polarizer so as to have a dark background, when the crystallized form of stearin will be observed as shown by Fig. 19; the stearin in this case has relatively increased from loss of palmitin and its natural oil in the process of compression and absorption.

FIG. 20. Palmitin—viewed by plain light, × 500.

FIG. 21. Palmitin and butter.

FIGS. 31, 32, 33, 34, 35, and 36 represent varied views ofold oleomargarine.

Having described the microscopical characteristics of these commercial fats, any microscopist by the aid of Plate VI may soon become able to distinguish pure fat from that which has been adulterated.

ORIGINAL MICROSCOPIC RESEARCHES IN FOOD FATS, WITH SPECIAL REFERENCE TO LARD AND OLEO COMPOUNDS, SUGGESTED BY RECENT DISCLOSURES IN LARD ADULTERATION

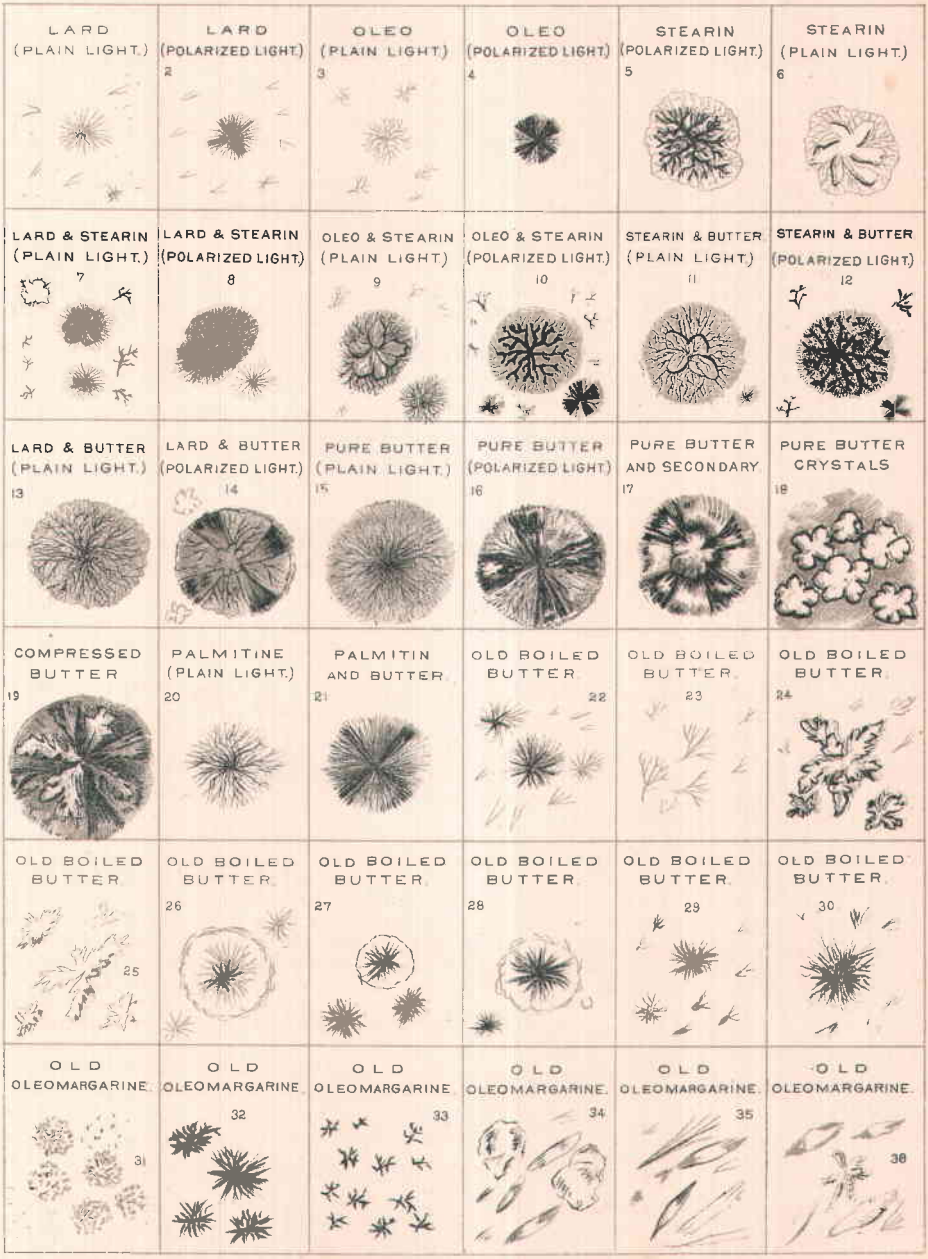
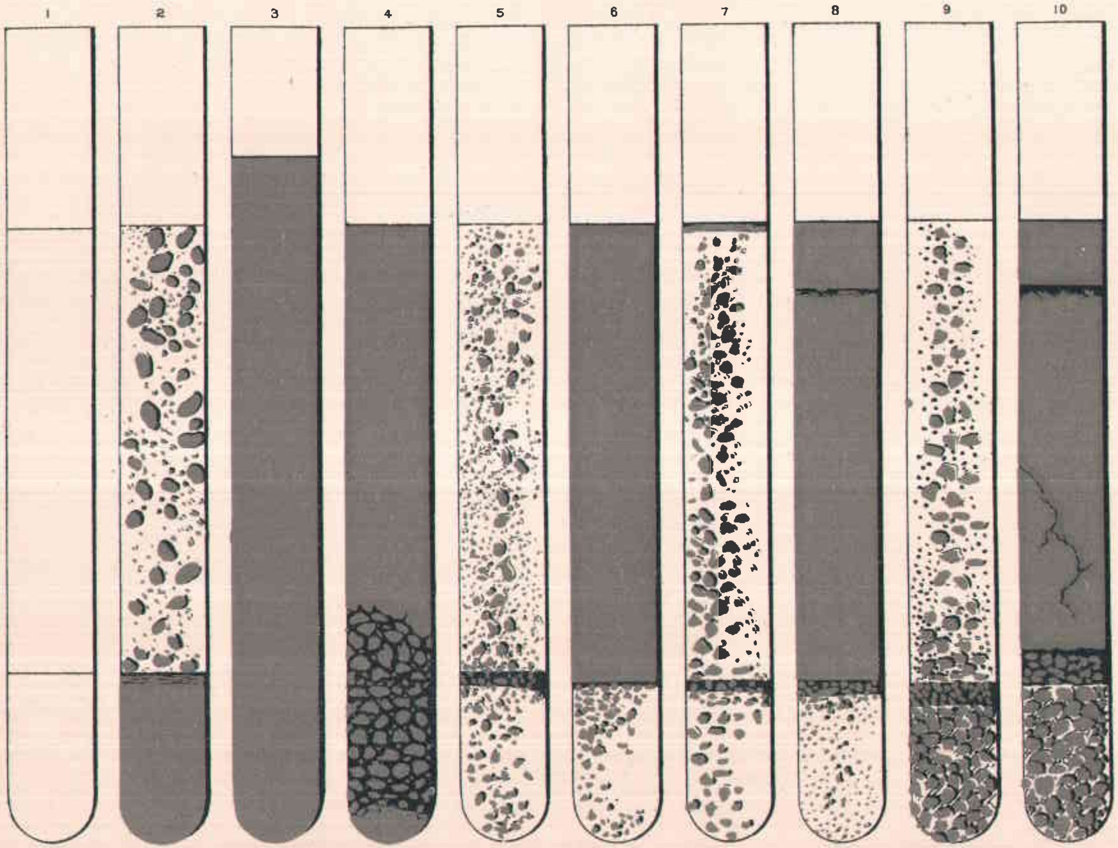


PLATE 7.

NITRATE OF SILVER TEST OF FOOD AND MEDICINAL OILS.

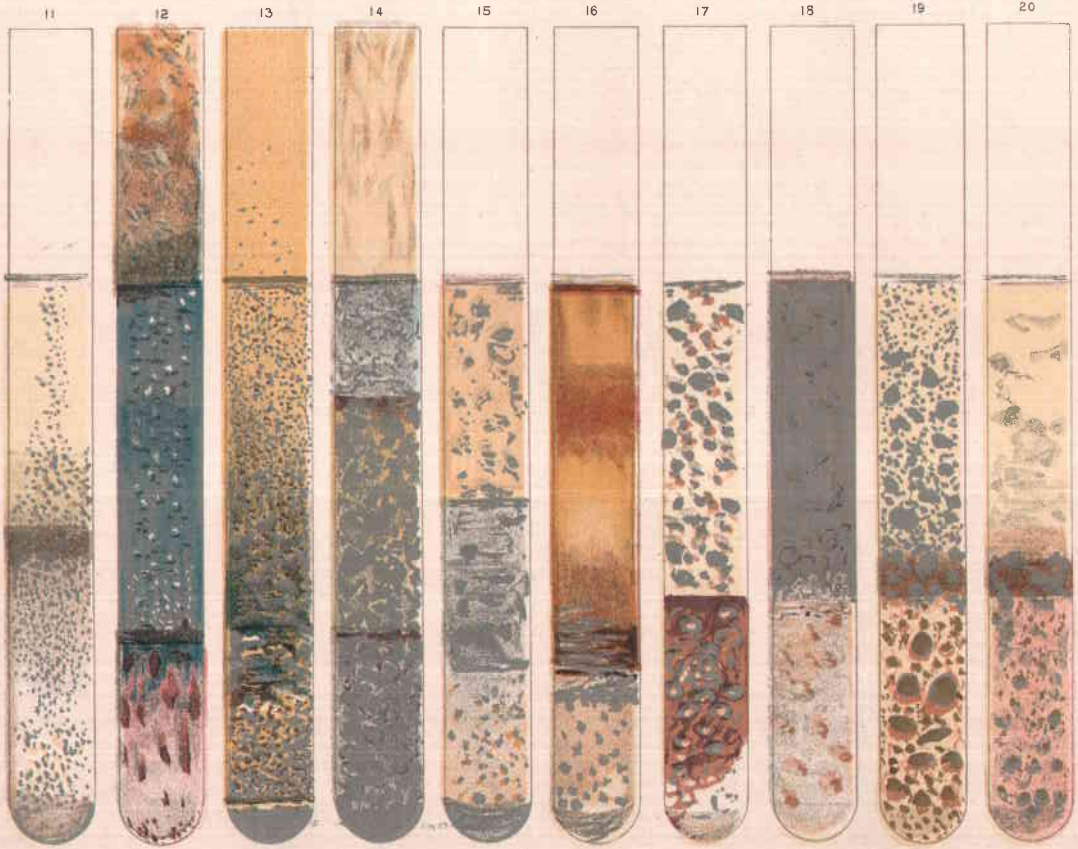
WITH AND WITHOUT PHENOL.



Strecker Lith. Co. Roch. N.Y.

NITRATE OF SILVER TEST OF FOOD AND MEDICINAL OILS.

WITH AND WITHOUT PHENOL.

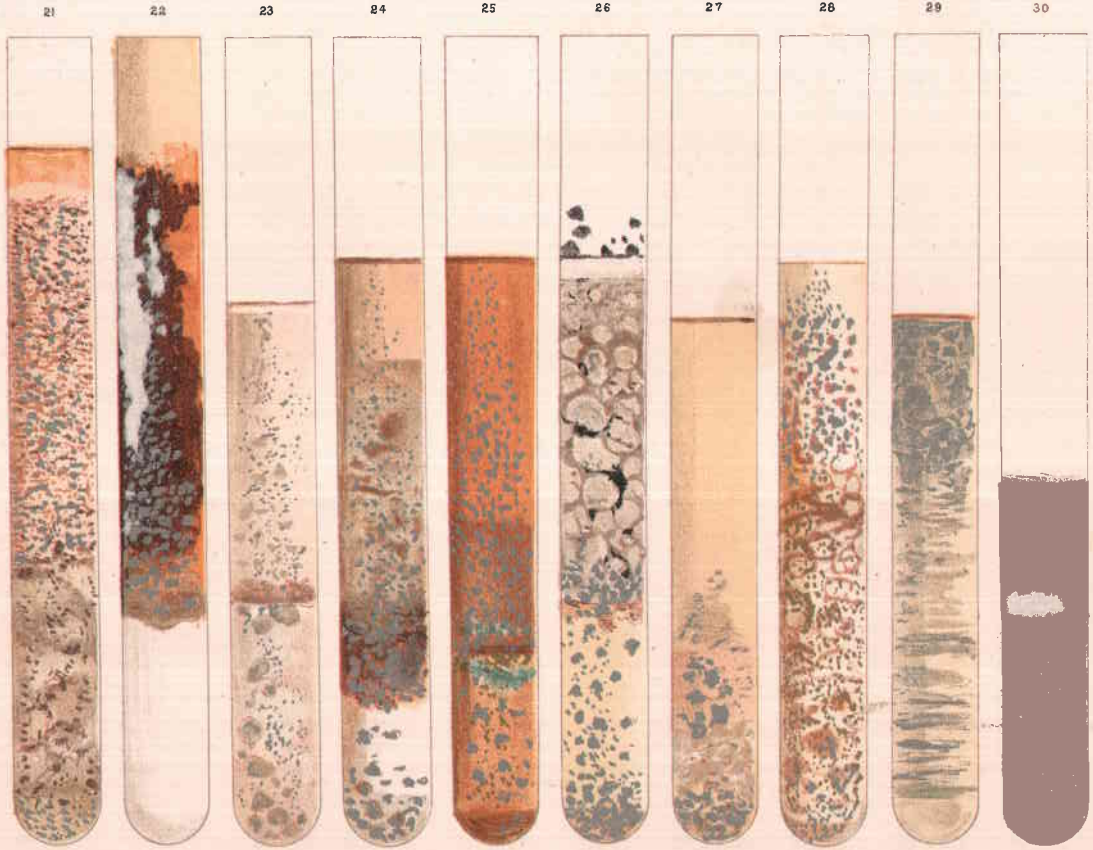


REPORT OF MICROSCOPIST, U.S. DEPARTMENT OF AGRICULTURE 1890.

PLATE 8.

NITRATE OF SILVER TEST OF FOOD AND MEDICINAL OILS.

WITH AND WITHOUT PHENOL.



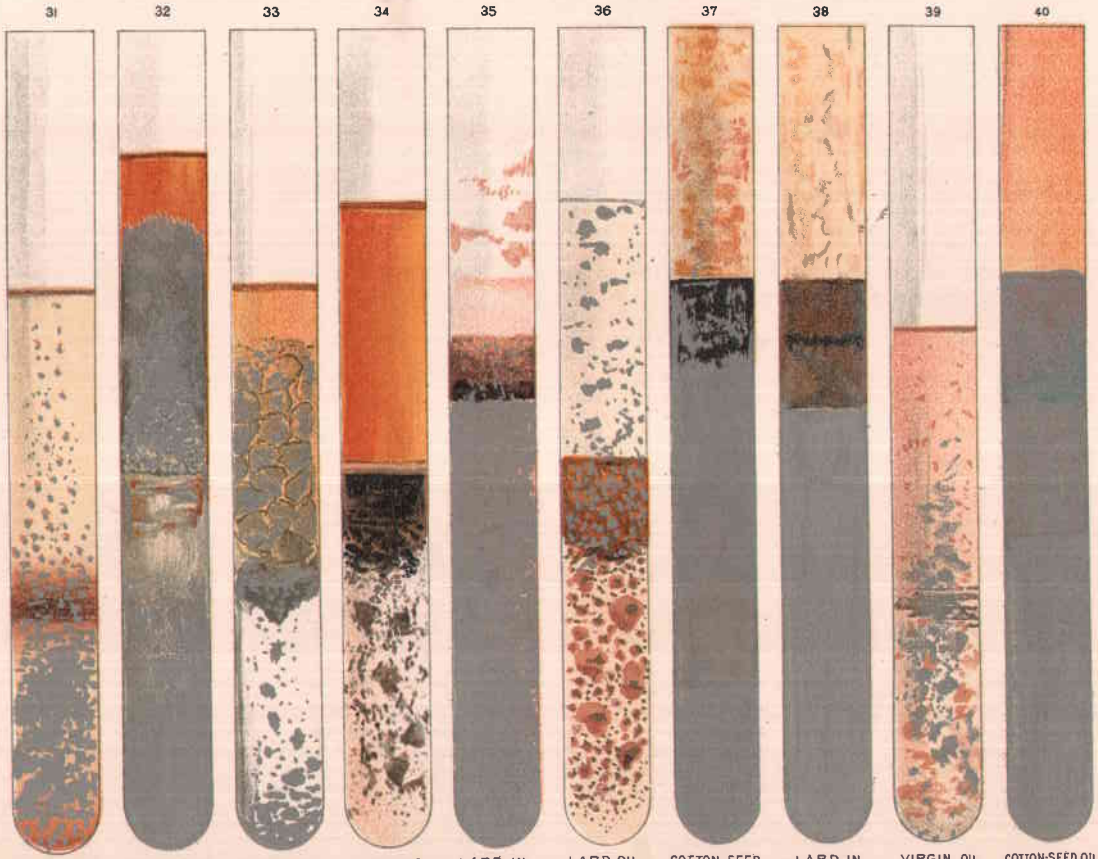
Strobridge Co. Print., N.Y.

REPORT OF MICROSCOPIST, U.S. DEPARTMENT OF AGRICULTURE 1890.

PLATE 9.

NITRATE OF SILVER TEST OF FOOD AND MEDICINAL OILS.

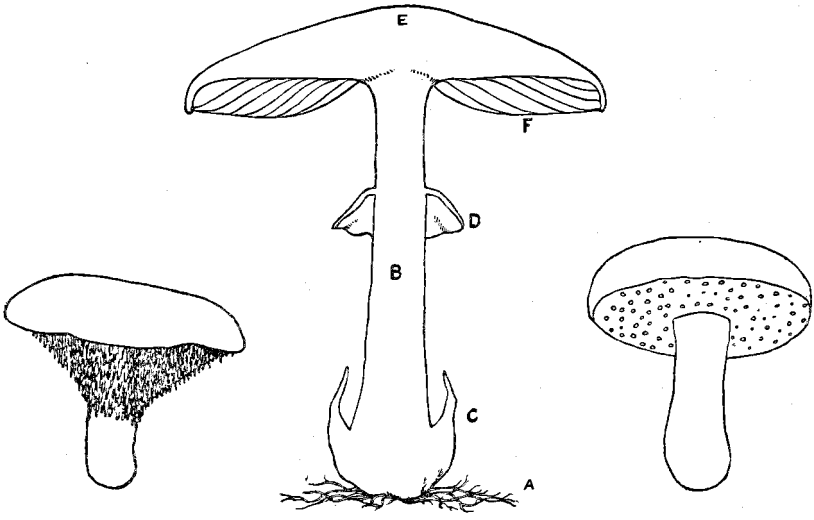
WITH AND WITHOUT PHENOL.



Strobridge Lith. Co. Cincinnati, O.

REPORT OF MICROSCOPIST, U.S. DEPARTMENT OF AGRICULTURE 1890.

PLATE 10.



Hydnum.
Spine Mushroom.

Agaricus.
Gill Mushroom.

Boletus.
Pore Mushroom.

A. Mycelium, or spawn.
B. Stipe, or stem.
C. Volva, or wrapper.
D. Annulus, or ring.
E. Pileus, or cap.
F. Lamellæ, or gills.

REPORT OF THE BOTANIST.

SIR: I have the pleasure of presenting herewith a report of the work of this Division for the year 1890. The report contains a general statement of the concerns of the Division and a few short papers on matters of general interest. The articles on forage experiments in Kansas and in Mississippi are preliminary to full reports to be presented for publication as bulletins.

Respectfully,

GEO. VASEY,
Botanist.

Hon. J. M. RUSK,
Secretary.

INTRODUCTION.

The Section of Vegetable Pathology having been created into a separate Division, its work will be separately reported upon.

The appropriation for the Botanical Division provides for experiments with forage plants, the development of the herbarium, and other economic botanical work, mentioning specifically that upon medicinal plants.

FORAGE EXPERIMENTS.

Grass Experiment Station at Garden City, Kansas.—The Station was established in August, 1888, with Dr. J. A. Sewall, of Denver, as superintendent. A short account of the plan of experiments undertaken in the year 1889 is given in the report of the Botanist for that year. During the present year these experiments have been continued and others instituted, so that with the added experience of the previous year encouraging indications of practical and valuable results have been attained. A statement of the experiments and processes is given on page 383.

Grass experiments at Agricultural College, Mississippi.—By an agreement between the Secretary of Agriculture and Prof. S. M. Tracy, Director of the State Agricultural Experiment Station of Mississippi, a series of forage experiments has been for two seasons conducted in that State under the direction of the Botanist of this Department and the superintendence of the director of the Station. By this arrangement the expense of leasing land and putting up buildings was saved to the Department, and excellent management of the experiments was insured. The Station itself is benefited by the direct interest of the Department in its forage questions and by its ability to make immediate local application of the results. A preliminary report of this work is given on page 378.

OTHER EXPERIMENTS.

The results attained at the Garden City Station are only in a general way applicable to the whole area of the arid lands. The climatic conditions vary exceedingly, even within this area, and while over a comparatively large portion the experiments and methods here used are satisfactory, for other portions it is necessary to make new experiments and to test the methods first found useful. To accomplish this end arrangements have been made with the United States Agricultural Experiment Stations at Fort Collins, Colorado, and Tucson, Arizona. About 5 acres of land was prepared at each of those stations, and sown to seeds of grasses and forage plants, with very poor results, probably due in part to the newness of the land. The experiments will be continued. Arrangements have been made with the Experiment Station at Las Cruces, New Mexico, and the Experiment Station at Logan, Utah, for grass and forage experiments next season.

HERBARIUM.

During the last two years means have been given to the Division to make collections of plants in little known regions, to provide for their identification, and to publish the results.

During the present year Dr. Edward Palmer, an old and experienced collector, has explored remote parts of Lower California, Western Mexico, and Arizona, making valuable collections, which add materially to the knowledge of the botanical character and resources of those regions. Mr. J. H. Simpson was employed from May to August, inclusive, to collect plants in the region of Manatee, Florida. He collected such species as were known to be rare, or not to have been found there previously, and made an annotated list of all the plants of that district. Mr. G. C. Nealley, of Houston, Texas, has been collecting since April 15, in Western Texas, for the most part in the desert lands. He was directed to make collections of as nearly as possible all the plants seen, and to take note of such as promised to be of value in the forage experiments. The plants collected in 1888, 1889, and the present year form the basis of a flora of Western Texas, now in preparation by Prof. J. M. Coulter under the direction of the Botanist. On the 15th of September Mr. C. R. Orcutt, of San Diego, California, started on a collecting trip for the Department in the Colorado Desert of Southern California. The specimens from this excursion have not yet been received. Other collectors have been employed for shorter periods, and have added materially to the growth of the herbarium.

The continuation of this method of obtaining specimens will enable the Department to have fully represented in the herbarium the plants of regions before little explored, and will insure a valuable stock of specimens for exchange. It will be possible before the lapse of many years to prepare, from the data now accumulating, handbooks covering the botany of the southwestern States and Territories. Since the establishment of the United States Agricultural Experiment Stations, there has been an especial demand for such publications.

In addition to the specimens collected by the Division others have been received in exchange, by purchase, and by contribution, so that the number of sheets added to the National Herbarium during the year July, 1889, to July, 1890, is about 6,000.

Exchanges of specimens from the herbarium have been carried

on ever since its establishment. Most of these exchanges have been made for the purpose of adding desirable specimens to the collection; but with certain institutions, namely, the State Agricultural Colleges, the exchanges assumed the character of a duty. The Division has continued to donate specimens and is desirous to aid the colleges in every practicable way. Within the last few years several of the Experiment Stations, not having access to any herbarium, have applied to the Department for aid, and have received sets of accurately identified economic plants. These sets have been found especially necessary for reference by the Station botanists in the naming of forage plants under experiment.

MEDICINAL PLANTS.

The work on medicinal plants thus far done by the Division has been confined, for want of sufficient means, to the illustration and description, in the Annual Reports, of a small number of native species known to have value in medicine. The object of such reports was merely to enable persons of little botanical education to identify the plants. In certain portions of the United States the collecting of native drugs is an important local industry. It is proposed to continue the investigation of our native medicinal plants, with reference to their commercial and economic relations. It is desirable to make experiments in the collection of such kinds as are becoming scarce in the wild state. Many requests come to the Department for seeds of the well known medicinal plants of foreign countries, with the view of attempting their cultivation. An effort will be made to obtain a supply of seeds of such kinds as are suited to our climate.

PUBLICATIONS.

Until the present year all the publications of the Division, except the Annual Report of the Botanist, were issued in a series of bulletins. The subject-matter of these bulletins was of so varied a nature and was directed to such different classes of readers that it was found desirable to institute a new series of publications to contain matter not of direct economic importance. This was accordingly done, by authority of the Secretary, and the title "Contributions from the United States National Herbarium" was adopted. The economy of this course lies in the fact that a smaller edition of these publications is required, and a separate mailing list is kept for them. The Bulletins henceforward will contain economic reports, the Contributions scientific matter. Since my last Annual Report the following publications have been issued:

Special Bulletin. The Agricultural Grasses and Forage Plants of the United States, by Dr. George Vasey. A new, revised, and enlarged edition, with 114 plates. 1889. (Pp. 1–148, with 114 plates engraved on wood, 8°.)

Bulletin No. 12. Grasses of the Southwest: Plates and Descriptions of the Grasses of the Desert Region of Western Texas, New Mexico, Arizona, and southern California. Part 1. By Dr. George Vasey. Issued October 13, 1890. (Pp. 1–8+100 [unnumbered], with 50 lithograph plates, royal octavo.)

Contributions from the United States National Herbarium, No. 1. Issued June 13, 1890. I.—List of plants collected by Dr. Edward Palmer in 1888 in southern California; by George Vasey and J. N. Rose. II.—List of plants collected by Dr. Edward Palmer in 1889 at (1) Lagoon Head, (2) Cedros Island, (3) San Benito Island, (4) Guadalupe Island, (5) head of the Gulf of California; by George Vasey and J. N. Rose. (Pp. I–VIII+1–28, 8°.)

Contributions from the United States National Herbarium, No. 2. Issued June 28, 1890. Upon a collection of plants made by G. C. Nealley in the region of the Rio Grande, in Texas, from Brazos Santiago to El Paso County. By John M. Coulter. (Pp. I–IV+29–61+index, 8°.)

INSECURITY OF THE HERBARIUM.

The present insecurity of the National Herbarium from fire is the cause of constant anxiety to those acquainted with its condition. The collections have an actual market value of about $20,000, and as certain portions could never be duplicated if destroyed, an additional value, hardly to be estimated in money, is given. So fully is the necessity of safe quarters realized throughout the United States that the American Association for the Advancement of Science, at its annual meeting for 1890 in Indianapolis, passed resolutions calling the attention of the Secretary of Agriculture and of the Secretary of the Smithsonian Institution to the present insecurity of the Herbarium, and expressing an earnest desire that measures be taken to insure its safety. Taking into consideration the need of safer quarters and the inadequacy of space in the present building, it is earnestly recommended that a commodious fire-proof building, or portion of a building, be provided for the National Herbarium.

MISSISSIPPI EXPERIMENT STATION.

By S. M. TRACY.

In 1888 Congress made provision for the prosecution of experiments in the culture of forage crops, under the supervision of the Department. One of the stations for this work was located at the State Experiment Station at Agricultural College, Mississippi, and placed in charge of S. M. Tracy, the director of the Station. Seeds of all the species which could be found in the markets were procured, and correspondents in India, Australia, and other foreign countries added many additional species. Seeds of the most promising native sorts were collected, and during the past two seasons one hundred and sixty-one species of grasses and thirty-eight of other forage plants have been under test. Nearly all of these have grown on three sets of plots in order to test their value for different soils, and thirty-seven of them have been cultivated in the field on areas of from 1 to 5 acres. Details in regard to the growth and character of each, their probable value for cultivation in the Gulf States, together with results of chemical analyses, digestion tests, etc., will be given in a special bulletin soon to be issued by the Department, while the general results with the leading sorts are summed up as follows:

With so many species, coming as they did from all parts of the world, it was not expected that all, or even many of them, would prove valuable for cultivation under the peculiar climatic and soil conditions which exist in the Gulf States, where the growing season for different plants extends nearly through the year, and where protracted summer drouths and excessive winter rains make it necessary that hay and pasture fields should be able to resist great atmospheric extremes. A large majority of the native forage plants in this region commence their growth late in the spring, but from about the 1st of April until December the pastures are abundant, and certain kinds of hay may be cut at any time from June to November. The great desideratum for this region is a plant which will make a fair growth for pasture during the cool and rainy months of the winter. Whatever may be used for this purpose should be a perennial, so

that fields need not be reseeded often; it should be adapted to great differences in soils; the roots should be able to endure continued drouth, and the forage must be relished by all kinds of stock. We have no plants which continue an active growth throughout the year, so that for a winter pasture plant we are obliged to look for one which will not be choked out and destroyed by other plants which occupy the ground during the summer months. Among those species which have succeeded the best have been the following:

ORCHARD GRASS (*Dactylis glomerata*).—This grass has given us a better winter growth on heavy clay soils, without attention, than has any other species which we have tested. It commences its growth with the first warm days of February, and if not pastured is ready to cut for hay in May, and will then afford excellent grazing until checked by the summer drouth. With the first fall rains it starts a new growth of leaves, making excellent fall pasture, and keeping fresh and green all winter. Its habit of growing in large clumps is against its use as a hay grass, but it bears grazing well, recovers quickly when cropped down, and makes its best growth during the cooler parts of the year.

RESCUE GRASS (*Brumus unioloides*).—This is an annual winter grass which produces even more abundantly than does the orchard grass, when sown on rich and not too heavy soil, but requires more care in its management. If sown in September or October it will usually make a heavy growth during the fall, and is often ready to cut for hay as early as February, and may be cut once or twice more before June. It disappears on the approach of hot weather, and if it is desired to make the field a permanent meadow should not be cut after April, so that the last growth may ripen seed. With favorable rains the seed will germinate in September or October, and will then furnish abundant food during the winter. Where stock can be taken from the pasture in time to permit the maturing of the seed the grass will be practically permanent, but if this is not done it will disappear after two or three seasons. Sown with equal care it will give a better winter pasture than either oats or rye, and in the spring can be plowed under with equal advantage as a fertilizer. When properly handled it is one of our most valuable sorts, but unless it receives attention to secure it an opportunity for self-seeding it can not be relied on to form a permanent sward.

WATER GRASS (*Paspalum dilitatum*).—This is a perennial species which is indigenous throughout the Gulf States, and which seems well worth cultivating. It grows from 3 to 5 feet high, bears drouth well, and will grow on almost any soil. It is somewhat difficult to propagate, as many of the seeds fail to germinate and it spreads slowly from the roots, but when once established it lasts indefinitely, remains fresh and green through the winter excepting for a few days after severe freezes, and is easily killed out when it is desired to bring the field into cultivation. It grows best on low ground, but when it has been planted on dry clay hills it has made an excellent growth, and now (November 15) covers the ground with a dense mass of fresh green leaves. It bears grazing well, is relished well by all kinds of stock, and may be safely recommended for any locality south of latitude 35°. We do not know that the seed has ever been offered for sale.

CARPET GRASS (*Paspalum platycaule*).—This is a perennial species which is indigenous to the southern part of the country, and which has spread northward until it is now found occasionally as far north

as Starkville, Mississippi, but which is not abundant excepting along the coast region. Its flat and spreading habit makes it of no value for hay, but it furnishes excellent grazing during nearly the entire winter. It grows best on rather low lands, and will bear closer grazing and more tramping than any other grass we have. It starts slowly from the seed, but when once established it grows rapidly, and a single plant will cover from 10 to 20 square feet in a season. It roots at every joint like the Bermuda, but unlike that, it can be readily destroyed by cultivation. In favorable locations it occupies the ground to the exclusion of all other plants, even the bitter-weed (*Helenium tenuifolium*) being unable to grow through the close sod. It starts slowly but plants from seed planted in March are now (November 15) 8 feet in diameter and are unchecked by heavy frosts.

TERRELL GRASS (*Elymus virginicus*).—This is another native perennial which has received but little attention, but which is of considerable value for winter pasture. It grows most abundantly along creek banks and on the borders of the woods, but will grow on almost any soil. Its best growth is made during the fall and winter months, and is ready to cut in May, but the hay made from it is rather poor quality. Although a perennial it is best to take stock off the field sufficiently early to allow the roots to become strong enough to stand the summer drouth. Mr. A. S. Yarbrough, of Como, Mississippi, who has grown it for many years, says:

> It will stand cold and heat without injury, but it can not stand pasturing in summer. It and Japan Clover are the only forage plants that we need, and about the only ones that are worth growing. If sowed in September on either plowed or pastured land, when the fall rains commence it will begin to grow and be from 2 to 10 inches high by December 15, after which it can be grazed in suitable weather through the winter and spring, when the land ought to be allowed to grow into Japan Clover or Bermuda, but never pastured during the summer.

Experience with this grass at the station indicates that, like the Australian oat, it will be of considerable value under good management, but of little use when it fails to receive the necessary attention.

TEXAS BLUE GRASS (*Poa arachnifera*).—This is one of the most widely advertised grasses in the whole South, but its real value for general cultivation is still problematic. It is a perennial, and emphatically a winter growing species. In favorable locations it begins its growth in October, and from November to May furnishes an abundance of luxurious pasturage. It matures its seed in April, and by the 1st of June the leaves become dry and withered, and little is seen of it until October. It is difficult to propagate from the seed, but can be increased rapidly by means of suckers, which are produced in immense numbers. From the fact that it takes its period of rest during the summer it is able to endure the longest drought without injury, and Professor Shelton reports that it is not injured by cold in Kansas. A rich loamy soil seems necessary for its successful growth, and in many places where the soil has appeared suitable the growth has been disappointing. At the Station it has been planted in a dozen or more places and with varying results. On rich light soil it has made a compact vigorous sod, which fully covered the ground in six months after planting, and has furnished excellent grazing for two years. Planted on equally good and well prepared ground with Bermuda it has lived, but has increased very little, and only occasional plants are to be seen during the late winter and spring months. On dry stiff clay it has nearly all died during the first season, and on the so-called "black prairie" lands

it has succeeded admirably. We have had no trouble in growing it from seed when sowed in beds and cared for, but have failed wholly in three attempts to grow it by sowing broadcast in the field.

RED TOP (*Agrostis vulgaris*).—On low and damp soils this is a valuable grass, as it remains fresh and green throughout the winter, furnishes excellent grazing, and is not easily killed by overflows, even when covered with water for two or three weeks at a time. We have found no better grass for marshy lands and "seepy" hillsides, and it has done moderately well where the ground was quite dry. During the first season after sowing it makes but little show, but becomes stronger and more dense with age, and maintains itself well against weeds and other grasses. It will produce one cutting of good hay, but its chief value here is as a winter and early spring pasture.

CRAB GRASS (*Panicum sanguinale*).—This grass is found everywhere throughout the south in cultivated fields, where it springs up after cultivation has ceased for the season and makes from 1 to 2 tons per acre of excellent hay. On land which was plowed in February we have cut four crops of about 1 ton each this year. As its best growth is made in cultivated fields, and at a season when other forage is abundant, it is not of special value for grazing, but as the hay made from it is of very good quality, and costs nothing but the cutting, it is highly prized by many farmers.

BERMUDA (*Cynodon dactylon*).—This is one of the most widely diffused and best known of southern grasses, being found in all of the country south of the Ohio River. It is a perennial, but starts late in the season, and is killed down by moderate frosts. It succeeds best on rich bottom lands, where it will yield two cuttings in a season, making from 2 to 4 tons of hay per acre. This hay is of the very best quality, being especially valuable for horses and mules. When once established in a field it is very difficult to eradicate, and this is a decided objection to its general cultivation.

JOHNSON GRASS (*Sorghum halepense*).—This is at the same time oue of the most valuable grasses and one of the most troublesome pests to be found in the South. It is a perennial which is easily propagated either by seeds or roots. It makes its best growth on rich bottom lands, where it soon occupies the whole ground, and will give three cuttings of about 2 tons each when in good condition. The hay is of excellent quality and is relished by all kinds of stock. The thick and fleshy roots soon become interlaced and matted in the soil, so that at intervals of three or four years the yield of hay is materially decreased, and the ground should be broken and harrowed, after which the grass becomes as vigorous as when first planted. The planter who wishes to grow hay and nothing else will find this a valuable species. As it requires a loose soil for its growth, it is of but little value for grazing, and but little is seen of it the second season that land is pastured. The objections to its cultivation are the rapidity with which it spreads to fields where it is not wanted, and the great difficulty of eradicating it from fields where it has become established. When fields are pastured it will soon almost disappear, but the roots remain alive and will again take possession of the field as soon as it is plowed. Instances are known where fifteen and even twenty years of continuous pasturing have failed to produce any appreciable effect on the vitality of the roots. It can be killed by covering with salt to the depth of an inch or more, and weekly hoeings

for a year will destroy most of it, but the work must be continued during the second season to make it complete.

Through the Gulf States are a number of forage plants, not grasses, which add largely to both the hay and pasture resources of the country, and which should be mentioned in this connection. The most important of these is Japan Clover (*Lespedeza striata*), which was introduced—probably from Japan—about thirty years ago, and which has now become thoroughly naturalized as far north as the Ohio River. It is an annual, but when introduced it perpetuates itself without care, and will make a fair growth on the poorest and dryest of clay hills. It starts rather late in the spring, making but little show before June, but from that time on it grows rapidly and is eaten greedily by all kinds of stock. It continues its growth until killed by frost. On sterile soil its growth is flat and spreading, and it is fit only for pasture, but where the soil is of good quality it will grow from 20 to 30 inches in height and yield from 2 to 3 tons of hay per acre, which is fully equal in value to the best clover hay, and is probably the most profitable hay which can be grown here for feeding to milch cows or for fattening purposes.

ALFALFA (*Medicago sativa*) has been grown with varying results. On moderately rich and somewhat sandy soils it has proved very valuable for soiling purposes, furnishing cuttings as early as February, with frequent successions until late in summer. It also furnishes excellent winter pasture and is a profitable crop on suitable soils. On heavy clay, and dry hills, its growth has been weak and unsatisfactory. If pastured on alfalfa during the spring, cattle are seldom injured, but if not accustomed to it they are frequently attacked by bloat when turned into a field containing a rank growth, though it is probably no more dangerous in this regard than is red clover.

MELILOTUS (*Melilotus alba*).—This plant bears a close resemblance to alfalfa, but is larger and coarser in every way and is especially adapted to use on calcareous soils. It will make an excellent growth on the "rotten limestone" hills which are so barren that they will sustain no other plants, but is of almost no value on the red clays which contain but little lime. It is not generally liked by animals unaccustomed to its use, but it starts into growth very early in the spring when green forage is scarce, and if stock are turned onto it at that time they very soon acquire a taste for it and eat it readily through the remainder of the season. When grown for hay one crop can usually be cut in the fall, after sowing in the spring; and during the next season two crops may be cut, after which it should be allowed to mature seed. Unless cut early the stems become hard and woody, and in all cases care is necessary in handling in order to prevent the loss of leaves, which drop from the stems very easily. Excellent hay can be made by sowing melilotus on lands which have been set in Johnson grass, the mixture seeming to improve the palatability of both. From land cultivated in this manner we have seen three cuttings, of about 2 tons each, made in a season.

MEXICAN CLOVER (*Richardsonia scabra.*)—This is an annual plant belonging to the *Rubiaceæ* or Madder family, which has been introduced from Mexico. It makes its growth during the latter part of the season, coming up in cultivated fields after other crops have been laid by or removed, and by fall covering the ground with a dense growth of about 2 feet in height, and making a heavy yield of excellent hay. Enough seed will be left on the ground so that it will

not need to be sowed a second time. The plant is so succulent that the hay is somewhat difficult to cure, but is relished by all kinds of stock. It succeeds best on the sandy lands in the pine woods along the coast, but has made heavy crops when sown on rich soil at the station, and a moderate crop the second season on the same land without plowing. It is excellent for late summer and fall pasture, but is worthless at other times.

Many of the grasses and forage plants which are valued highly in the North have proved of little use when planted here. Among the more prominent are these:

TIMOTHY (*Phleum pratense*), which makes a weak growth for a year or two, but soon succumbs to the encroachments of the more vigorous native grasses and weeds. The apparent reason for this is that the bulbs and roots become so weakened by the continued growth to which they are stimulated during the "warm spells" of winter, that they are unable to withstand the strain of the summer heat and drouth.

KENTUCKY BLUEGRASS (*Poa pratensis*) is also practically a failure here. Where the soil is rich and moist, especially if partially shaded, it will make a weak growth, but will very rarely make the close and even sod so characterestic farther North. Repeated attempts to grow it here have been made during the last ten years, but total failure is the almost invariable result. Occasional patches of it may be seen, but these are not of sufficient size or evenness to be of any value either for pasture or lawn.

MEADOW FOXTAIL (*Alopecurus pratensis*) has done but little better than timothy, though it has afforded slightly better grazing.

None of the Fescue grasses (*Festucas*) have done well. They grow fairly during the cool weather, but the warm summer rains cause them to decay.

The Ray grasses (*Loliums*) have also proved worthless. They start readily from seed sown either in fall or spring and make a vigorous growth till warm weather comes, after which they dwindle and soon disappear. We have succeeded in preserving plots through the summer only with the greatest care, and from five sowings in the field of the Italian, English, and perennial varieties we have nothing left excepting an occasional plant. None of them seem able to stand our long summers, and can not be recommended for the Southern States.

RED CLOVER (*Trifolium pratense*) is of far less value here than in the Northern States. It starts readily, and may be cut two or three times during the season, but usually ceases to grow in July or August, and the fall rains stimulate such a vigorous growth of other plants that the clover is choked out and the next year the stand is "patchy" and irregular. On occasional fields the clover will maintain itself for several years and produce heavy crops, but such fields are quite exceptional.

EXPERIMENT STATION AT GARDEN CITY, KANSAS.

In the Report of the Secretary of Agriculture for 1889, in the botanical part, there was published an account of the organization of an Experiment Station at Garden City, Kansas, for the purpose of experimenting in the cultivation of grasses and forage plants suitable to the arid districts of the West. A statement was made

of the work which had been performed up to that time. I will now continue this report for the present year. The land was plowed and put into as good condition as possible, the newly broken ground was again plowed, the sod cut into pieces with the disk harrow, and further pulverized by means of a special thousand-toothed harrow, invented by the superintendent of the Station, Dr. J. A. Sewall. Two thousand pounds of seeds of native grasses had been collected the preceding autumn, and these, together with several hundred pounds of foreign seeds, were sown. The native seeds were of the following kinds; the amount of land for each kind is given:

Chrysopogon nutans, 2 acres.
Panicum virgatum, 20 acres.
Agropyrum glaucum, 5 acres.
Andropogon provincialis, 2 acres.
Andropogon Hallii, 1 acre.

The foreign grasses were as follows:

Festuca elatior, 5 acres.
Arrhenatherum avenaceum, 1 acre.
Holcus lanatus, 2 acres.
Agrostis stolonifera, 1 acre.
Bromus inermis, 3 acres.
Festuca heterophylla, 2 acres.
Festuca ovina, 2 acres.
Elusine Corocana, 3 acres.
Cynodon dactylon, 1 acre.
Lolium perenne, 2 acres.

Of foreign forage plants were the following:

Sainfoin (*Onobrychis sativa*), one half acre.
Spurry (*Spergula maxima*), one half acre.
(*Lotus major*), one half acre.
Serradella (*Ornithopus sativus*), one half acre.
Goats' Rue (*Galega officinalis*), one fourth acre.
Hairy Vetch (*Vicia villosa* and *Lathyrus hirsutus*), one fourth acre.
Bokhara Clover (*Melilotus alba*), one eighth acre.
Alfalfa (*Medicago sativa*), 10 acres.

In addition there were sowed and planted on the 160-acre field, 40 acres winter rye, sowed in September, 1889; 8 acres Polish wheat, and 80 acres in different varieties of sorghum.

The result for this year, so far as the grasses were concerned, was very disappointing. Most of the kinds germinated and made a satisfactory growth up to June 1, after which for want of rain they suffered sadly, and most of them at the end of the season were complete failures. Of those surviving, the most promising kinds were *Bromus inermis*, *Panicum virgatum* and *Agropyrum glaucum*. The two *Andropogons* and the *Chrysopogons* mainly failed, probably on account of the seed having been collected before it was mature. The failure of some is attributed to being sown on new ground in which the old sod had not become thoroughly disintegrated.

Of the forage plants *Galega officinalis*, *Anthyllis vulneraria*, *Onobrychis sativa*, and *Medicago sativa*, although they suffered much from the drouth, yet maintained life, and with a favorable winter will probably recover vigor the coming spring. There is encouragement to expect this from the fact that the same plants of last year's sowing maintained a vigorous growth in spite of the drouth of this season, some of them even affording a good cutting for hay. The most promising of these are: (1) Sainfoin (*Onobrychis sativa*); (2) Burnet (*Poterium* sp.); (3) Goats' Rue (*Galega officinalis*); (4) Spanish Clover (*Anthyllis vulneraria*).

The *Melilotus alba* or Bokhara Clover made a good crop, as it will no doubt do in the driest season, the only difficulty being that cattle do not like it and have to be trained to eating it. It is maintained, however, by many who raise it in the south that cattle are readily brought to eating and relishing it, and if that circumstance

can be depended upon there need be no want of abundance of forage on the most arid soils. But the discouragements of this year with respect to the growth of the grasses, were partly compensated for in another direction. Knowing that in California, Utah, and Arizona, where perennial grasses have not succeeded, some of the grains, as barley and wheat, are cultivated as forage, an experiment was undertaken with winter rye. About 40 acres of this were sown in September, 1889. This came up and grew well until winter, and in the spring of the present year up to the 1st of June, when the Superintendent of the Station (Dr. J. A. Sewall, of Denver) said it was equal to any rye he had seen in Colorado even with irrigation, and if the rainfall for June had been an average one it was estimated that it would have yielded 25 bushels per acre. About 2 acres were cut and made into hay, the rest grew until it was harvested, when it threshed out about 17 bushels per acre. Another experiment was with Polish wheat (*Triticum Polonicum*). About 10 bushels of this was sown in March and harvested about the 25th of June, maturing in about one hundred days. Up to the 1st of June this was very promising, but the drouth following prevented its full development; still it gave at harvest 8 bushels per acre of excellent wheat of this variety. In fact it attracted a great deal of attention. A sample of it was sent to the State Fair at Topeka, and would have taken first premium had it not finally been ruled out of the wheat list and classed with rye. The surplus of the rye and wheat, after reserving sufficient for the use of the Station, was gratuitously distributed to the farmers of the surrounding country for seed purpose, in quantities of from one half a bushel to 2 bushels, and it was eagerly sought for. The lesson of this experiment is that in the most unfavorable season it seems possible for the farmer to provide a large amount of fodder, as well as a fair quantity of grain, by utilizing the winter and spring rains.

In addition to what has been already mentioned, about 80 acres were planted to different varieties of sorghum, all of which presented an appearance of great thrift up to the 1st of June, when the drouth, and those peculiar desiccating winds to which Kansas is subject, arrested their development and ruined the greater part of the yield, only one variety, locally called Jerusalem corn (apparently a variety of Millo Maize), maintained a good degree of hardiness and vigor and matured a fair crop of seed, which is of great value as a feed for poultry, hogs, and other animals.

These experiments illustrate and emphasize the line upon which such investigations should be pursued. It is very rarely that the seasons fail at both ends of the year, and by a proper selection of grain, grasses, and other economic plants, there will rarely be a total failure of crops. The early maturing winter and spring grains and the hardier kinds of sorghums may be pretty confidently relied upon for food crops and fodder; then there is little doubt that the grasses and forage plants now under trial will prove successful, and other plants, as sugar-sorghum, corn, oats, beans, castor beans, root-crops, etc., may take the chances of the seasons, which three times out of four will probably be favorable to them. Certainly the immense importance of making these arid lands inhabitable will justify most protracted and exhaustive experimental work at this and other stations.

During this year the rainfall at the Station from the 1st of January until the 1st of June amounted to 9 inches, and from the 1st of

June until the 25th of October a trifle over 3½ inches, making less than 13 inches during nearly ten months, considerably less than the average of many years, and sufficient to account for the failure of many of the grasses.

By the kindness of General A. W. Greely, I am able to present a table of temperature and rainfall at Dodge City, Kansas, for a period of sixteen years. This place is on the 100th meridian, a degree farther east than Garden City. It will be noted that there is great irregularity in the amount of rainfall, particularly during the summer months. During the sixteen years given, the quantity for those months varies from 4.67 inches (for 1890) to 18.89 inches (for 1884). Only two other years of the sixteen was the summer rainfall nearly as low as the present one, viz, in 1876, 4.79 inches, and in 1882, 5.63 inches. The chances are that such a dry summer as the present will not occur again in many years, and if the grasses now living can be carried over the year they may be fairly established. The table of temperature gives only the average for each month. I am informed that for many days during the summer, at the Station, the thermometer reached from 103° to 110° in the shade. Very little vegetation can pass through such an ordeal as this intense heat combined with the prevailing drought.

Mean temperature at Dodge City, Kansas, since January, 1875, as recorded by the United States Signal Service Office.

Months.	1875.	1876.	1877.	1878.	1879.	1880.	1881.	1882.	1883.	1884.	1885.	1886.	1887.	1888.	1889.	1890.
January	13.2	35.3	23.9	32.0	23.9	36.2	20.1	31.1	22.1	25.6	18.4	16.5	27.1	23.8	28.9	27.2
February	29.8	41.5	37.1	38.2	32.5	39.3	26.8	38.1	26.2	28.5	25.8	35.0	30.5	37.7	29.0	32.4
March	38.1	34.7	42.6	49.3	47.7	40.2	39.8	46.8	40.8	41.8	40.9	39.0	44.6	36.5	45.8	42.5
April	47.9	56.6	50.1	55.9	57.0	54.8	53.1	52.5	53.0	49.1	54.4	51.0	54.4	56.9	56.6	54.2
May	65.4	64.5	62.7	61.9	68.9	68.2	63.6	56.5	60.5	59.5	58.7	67.5	65.4	60.5	63.7	63.6
June	75.4	71.2	70.6	70.5	76.0	74.7	76.9	73.1	70.5	71.2	71.2	71.2	74.0	74.5	69.8	75.0
July	75.5	79.6	77.5	80.0	80.4	76.4	77.8	74.6	76.2	76.6	76.3	78.2	78.7	80.0	77.5	82.4
August	74.6	77.2	76.2	79.0	75.6	74.8	78.0	73.9	71.7	71.9	73.1	78.2	74.8	74.4	76.9	76.4
September	68.7	66.7	68.4	67.9	66.2	65.8	67.7	68.0	64.1	70.3	66.0	67.6	68.2	67.8	66.3	65.2
October	56.6	52.6	51.7	54.0	59.5	51.6	56.5	56.6	50.8	57.6	57.3	58.8	59.7	55.1	55.6	55.5
November	39.9	38.4	38.6	43.4	40.7	26.2	37.7	40.1	41.8	41.6	45.2	38.1	42.5	41.2	37.4	.....
December	40.7	21.1	39.0	23.8	25.7	24.9	36.9	31.7	34.8	21.0	36.6	28.6	28.9	38.4	44.6	.....
Means	51.0	53.2	53.5	54.4	54.3	52.9	53.0	53.6	51.1	51.2	51.5	52.5	53.6	53.8	54.3	.....

Rainfall at Dodge City, Kansas, since January, 1875.

Months.	1875.	1876.	1877.	1878.	1879.	1880.	1881.	1882.	1883.	1884.	1885.	1886.	1887.	1888.	1889.	1890.
January	0.12	0.00	0.18	0.21	0.87	0.00	0.15	0.52	0.44	0.08	0.52	1.82	0.07	0.23	1.69	0.42
February	0.10	0.05	0.56	1.13	0.08	0.00	1.63	0.22	1.42	0.28	0.47	0.46	0.53	0.73	0.34	0.39
March	0.04	3.59	0.25	1.01	0.17	0.04	0.50	0.24	0.42	1.91	0.75	1.50	0.17	0.93	1.38	0.05
April	0.72	0.16	3.38	1.06	0.40	0.11	2.38	0.68	2.40	1.07	1.39	1.90	2.46	4.08	2.12	2.90
May	2.26	1.15	4.96	4.63	0 90	3.01	12.92	3.87	5.41	4.48	4.07	0.40	3.69	2.86	1.54	1.19
June	0.64	2.53	3.92	2.19	4.40	1.59	1.77	1.51	4.31	7.67	2.02	5.47	4.00	5.16	3.43	1.00
July	3.28	2.26	1.79	1.61	3.90	4.00	5.06	3.04	2.61	6.40	6.03	2.07	1.00	4.07	2.02	0.22
August	2.06	1.03	4.09	4.48	3.75	5.17	2.36	1.07	5.66	4.82	1.80	2.46	2.28	3.00	2.14	3.45
September	1.32	2.13	0.50	0.76	0.80	0.32	3.13	0.15	1.32	0.23	3.48	2.33	0.14	0.78	0.86	0.57
October	0.06	1.00	3.34	0.09	0.00	1.42	2.19	1.62	3.32	1.50	1.06	0.45	0.48	0.81	2.88	0.89
November	0.00	1.35	0.56	0.60	0.04	2.43	0.95	0.11	0.12	0.83	0.36	0.24	0.35	0.06	0.77	.....
December	0.09	0.15	4.36	0.19	0.12	0.03	0.61	0.11	1.07	1.10	1.76	0.25	0.54	0.23	0.00	.....
Total	10.69	15.40	27.89	17.96	15.43	18.12	33.55	13.14	28.50	30.36	23.71	19.35	15.71	22.94	19.17	.....

GRASSES FOR ARID DISTRICTS.

Many inquiries are made as to what grasses and forage plants can be tried in the arid districts. In general I will say, such kinds as are observed to thrive and produce a large or at least a fair amount of nutritious forage in the region under consideration. In our experiments we have rather acted on the supposition that any and everything might be given a trial, notwithstanding the probability that nine tenths of all kinds tried would prove failures. Repeated failures with any particular kinds will soon eliminate such from the list of further trials, and cause us to continue work with a greatly reduced number. Yet we may get much help from the establishment of some general principles.

(1) No perennial grasses with broad leaves can be expected to answer the purpose. Such kinds are of vigorous growth and require a large supply of water to come to maturity.

(2) Grasses with strong, deeply penetrating roots, are generally best adapted to endure long periods of drouth.

(3) Grasses with bulbous enlargement at the base of the culm, and these with thickened rhizomas, and those with creeping and rooting stems are generally able to bear drouth on account of the nutriment stored up in their tissues. Some species of Panicum and some of Phalaris are promising kinds, from this peculiarity.

(4) Some kinds produce a large quantity of foliage near the ground, which serves as mulch to protect the soil beneath from rapid evaporation, and are able hence to survive drouth. Of this kind is *Bromus inermis*, a European grass recently introduced; *Lolium perenne*, or perennial rye grass; and *Festuca elatior*, or tall fescue. The common grama grass, *Bouteloua oligostachya*, and buffalo grass, *Buchlœ dactyloides*, owe their value largely to the property of forming a close mat of interwoven stems and leaves upon the surface of the ground. *Sporobolus cryptandrus* and *Sporobolus airoides*, two kinds of wire grass native to the plains, owe their persistence to their hold upon the ground by means of their strong penetrating roots.

(5) Generally the grasses for cultivation in arid soils are to be sought for in the arid country itself. They are existing there, but in small quantities or in special localities, and are waiting to be looked up and brought under the protecting influence of cultivation. True, there are several desert regions where at present agriculture is impossible without irrigation, but even in southern New Mexico and Arizona there are broad elevated plains where water is obtainable within less than a hundred feet, and where there is evidence in the existing vegetation that systematic cultivation of properly selected grasses might be expected to secure a greatly increased production of useful vegetation. The grasses which I would select for cultivation there, are very different from those I would recommend for Kansas and similar northern regions. Among the species I would select in that region are: (1) *Panicum virgatum*, sometimes called Switch grass; (2) *Panicum bulbosum*, with thickened bulb-like culms; (3) *Setaria caudata*, a kind of perennial pigeon-grass; (4) *Andropogon scoparius*, or broom-grass; (5) *Phalaris intermedia*, or Wild Canary grass; (6) *Sporobolus airoides*, and (7) *Sporobolus Wrightii*, sometimes called Saccatone; (8) *Pappophorum laguroideum*, with no common name. In addition to those some of the

European grasses and forage plants which are under trial at Garden City may be found suitable.

NOXIOUS WEEDS.

By F. V. COVILLE.

ORDER COMPOSITÆ.

Horseweed (*Ambrosia trifida*).

[Plate I.]

Plant annual, robust. Stem simple, erect, terete, striate, hispid, 3 to 10 or even 15 feet high, often 1 inch in diameter at the base. Leaves opposite, large, petiolate, 3-lobed, strigose on both surfaces; lobes oblong to lanceolate, acuminate, serrate; upper leaves often oblong-lanceolate and not lobed. Inflorescence a paniculate leafy cyme of slender racemes. Heads monœcious; staminate pendulous at the ends of filiform pedicels (about one fourth of an inch long), with a flat involucre about one fifth of an inch in diameter; pistillate few, sessile at the base of the raceme, 1 to 3 together in the axil of a leafy bract. Staminate flowers minute, several in each head; pistillate flowers single in the head, the involucre surrounding it closely and resembling an ovary. Fruit seed-like, obovoid, slightly compressed, one third to one half an inch long, about 6-ribbed, with several sharp tubercles toward the apex.

Horseweed is a native of the United States, and is distributed throughout the country east of and extending somewhat into the Great Plains. It grows in all tilled soils, but especially in rich river bottoms, forming, if left to itself, a dense growth and choking out most other plants. It is easily subdued by mowing and plowing. In copses and open woods along streams and by the margins of fields it is usually left to mature its fruit, and it is a matter of economy to mow such patches of the plant as often as they flower. The fruit, which exactly resembles a seed, is undoubtedly transported and widely scattered by the floods characteristic of alluvial plains, so that something more than the local extermination of the plant is necessary to prevent its growth.

One correspondent from Texas says that the plant makes a fodder which is freely eaten by horses and cattle.

Orange Hawkweed (*Hieracium aurantiacum*).

[Plate II.]

Perennial by slender rootstocks and by runners. Stem simple, erect, 1 to 1½ feet high, nearly leafless, densely hirsute, the hairs toward the apex of the stem black at the base. Leaves mostly radical, oblong-lanceolate, denticulate, hirsute on both sides, sessile, those of the stem 2 or 3, all but the lowest reduced to bracts. Heads in a bracted-cyme; peduncles with black glandular hairs and a close brown coating of stellate hairs; involucre about one third of an inch in diameter. its bracts linear-lanceolate, little imbricated, provided on the back with straight, glandular, and stellate hairs. Flowers all perfect, with ligulate orange-colored corollas. Achenia about 1 line long, dark brown, linear in outline, terete, 10-ribbed, truncate; pappus a row of dirty-white capillary bristles.

This plant has been recently introduced into the eastern United States from Europe. It has appeared thus far mostly in pastures and roadsides, where the grass is not tall, a single plant giving rise in a few years, by its rootstocks and runners, to a large patch tenacious of life, and taking almost complete possession of the soil.

When to this characteristic is added its capability of producing a large number of seeds adapted to dispersion by the wind, an idea of its pestiferous nature may be obtained. The orange colored flower heads are strikingly pretty.

ORDER SCROPHULARIACEÆ.

Toad flax (*Linaria canadensis*).

[Plate III.]

Plant perennial, spreading by rootstocks. Stem erect, usually unbranched, commonly 1 to 2½ feet high, smooth. Leaves numerous, alternate, sessile, linear to linear-oblanceolate, 1 to 2½ inches long, one twelfth to one fourth of an inch broad, acute at the apex, smooth. Flowers short-pediceled in an erect terminal raceme, elongating as it flowers to a length of sometimes 8 inches. Calyx of 5 ovate acute sepals about one sixth of an inch long, not enlarging in fruit. Corolla pale yellow, the parts united into a tube, irregular, 2-lipped, the orifice closed, three fourths to 1 inch long, with a straight, downwardly projecting spur; upper lip 2-lobed, erect; lower lip 3-lobed, bearded at the base, reflexed, spreading, middle lobe much the smallest. Stamens 4, borne on the base of the corolla-tube, anthers included. Ovary 2-celled; placentæ axile; ovules numerous; style 1, filiform, not projecting from the corolla; stigma capitate-bilobed. Fruit an ovoid obtuse pod. Seeds small, flat, circular, surrounded by a wing.

In appearance this is a pretty and, in mass, a striking plant, but when bruised it has a characteristic rank odor. It is native in Europe, but fully naturalized in the eastern United States in pastures, meadows, and roadsides. When once started in a place it spreads rapidly and persistently by its long rootstocks underground. Its favorite situation is in rather dry soils, and careful and persistent cultivation is required to exterminate it.

ORDER CONVOLVULACEÆ.

Clover dodder (*Cuscuta trifolii*).

[Plate IV.]

Plant annual, parasitic without chlorophyll. Roots none. Stem filiform, yellow, twining, attached to its host by sucker-like disks. Leaves reduced to inconspicuous scales. Flowers white, about one half of an inch broad, in small glomerate clusters. Sepals 5, ovate acute. Corolla gamopetalous, twice as long as the calyx, 5-lobed; lobes spreading, acute. Stamens 5, inserted on the corolla, each subtended by a large ciliate scale. Styles 2. Stigmas 2, elongated, not ciliate. Fruit a circumscissile capsule.

This parasite is a native of Europe, supposed to have been introduced into the United States with clover seed. It has appeared occasionally in various parts of the United States and within the last two years has been prevalent in Missouri.

There are twenty-one species of Cuscuta native in the United States, all leafless twining plants, with filiform stems, parasitic on various hosts. Three introduced species are known: One from Chili on alfalfa, another from Europe on flax, and the third the one under consideration. Clover dodder may be readily distinguished from all our other species, except flax dodder, by its elongated instead of capitate stigmas, and from that species by growing upon clover instead of flax.

A clover field usually becomes infested with the parasite from the sowing of seed containing that of dodder. The dodder seeds germinate in the ground, sending up slender leafless stems, which twine

about the clover and obtain nourishment from it through the disks that are soon developed. The lower part of the stem then dies and connection with the ground is lost. The yellow threads continue to develop rapidly until a circular patch of clover is covered by it, and the host becomes so weakened by the loss of its sap that it finally turns brown, dies, and rots.

The remedy is first to obtain a pure quality of clover seed. Dodder seeds are similar to those of clover, but of smaller size and capable of separation by screening. If a meadow is but slightly infested, each patch containing the parasite should be mowed and destroyed as soon as seen, and if no plants are allowed to seed the clover will be saved. When, however, a meadow is thoroughly sprinkled with dodder the whole must be plowed and other crops planted for a few years, when all the dodder seeds will have germinated and died. Under no circumstances should an infested crop be saved for seed.

ORDER PLANTAGINEÆ.

English Plantain (*Plantago lanceolata*).

[Plate V.]

Plant perennial. Rootstock short, thick, nearly erect. Leaves all radical, long-petioled; blade oblong-lanceolate to linear-lanceolate, acute or acuminate at both ends, 3 to 5, rarely 7 ribbed, denticulate, from pilose to nearly smooth, 3 to 6 inches long. Inflorescence a solid spike about one third of an inch in diameter, from 2 inches long to very short, borne on a naked slender scape about twice as long as the leaves. Flowers perfect, single in the axil of an ovate, 1-nerved, papery bract shorter than its flower. Sepals 3 (one composed of two united), papery, ovate; one 2-nerved, the others 1-nerved. Corolla in one piece, with four abruptly spreading, ovate, 1-nerved lobes, each about 1 line long. Stamens 4, borne on the tube of the corolla, not extending from it. Ovary 2-celled, 2-ovuled. Seeds 2, oval, rather flat, hollowed on one face, about 1 line long.

This plantain has long been naturalized in the United States, coming originally from Europe. It is now found throughout almost the entire country, in pastures, meadows, and lawns. Its seed is easily distinguished from that of grasses and other forage plants, which should always be examined before planting. If the weed is once established, plow it under and cultivate the soil for a year or more.

It has often been used as a forage plant in England, but in the United States it has proved thus far undesirable

ORDER GRAMINEÆ.

Bur Grass (*Cenchrus tribuloides*).

[Plate VI.]

Plant annual. Stem spreading and branching at base, from a few inches to 3 feet high. Leaves of the stem 3 to 10, usually glabrous; blade 6 inches long or less, 1 to 2 lines broad, flat or sometimes involute. Inflorescence a spike of burs, these consisting of a cluster of two or three spikelets inclosed in an involucre provided with barbed spines and bristles. Flowers in each spikelet 2, one staminate, the other fertile, grains when mature remaining inclosed in the involucre.

This native grass is common throughout the southern portion of the United States and Mexico, extending northward in warm, sandy regions into the Northern States. In some parts of the Great Plains it takes almost entire possession of cultivated fields late in

the season, ripening its grains for the next year, and offering great annoyance to cattle and to men. The barbed spines easily penetrate the flesh and are painfully irritating.

Thorough cultivation should be adopted until the crops are harvested, and after that sufficient plowing to prevent the maturing of the grains

NEW FODDER GRASSES.

We add here the figures and descriptions of two grasses which are considered as having much value for fodder in the South. They would have been included in a former publication but that the plates could not be prepared in season.

ORDER GRAMINEÆ.

Pearl Millet, Cat-tail Millet, Egyptian Millet (*Pennisetum typhoideum*).

[Plate VII.]

A tall, erect, thick-stemmed grass growing to the height of 6 feet or more. It has an abundance of broad leaves and is terminated by a spike-like panicle, which is compact and cylindrical; a foot long, and resembling the common cat-tail. The panicle is studded with small obovate grains, which are surrounded at the base by numerous coarse hairs or bristles. It is probably a native of the East Indies, where it has long been cultivated, and forms an important article of food. It is also cultivated in Arabia and in Central Africa. It has been cultivated in the Southern States for fodder and on rich ground produces an enormous yield. It may be cut several times during the season, and after cutting sends up numerous sprouts with broad, succulent leaves, and juicy sweet stalks. On rich ground it produces so abundantly as to make it difficult to find room to cure it into fodder. Cattle and horses are very fond of it both green and when cured. It is an annual, and will not mature its seeds except in a warm climate.

ORDER GRAMINEÆ.

Teff (*Eragrostis abyssinica*).

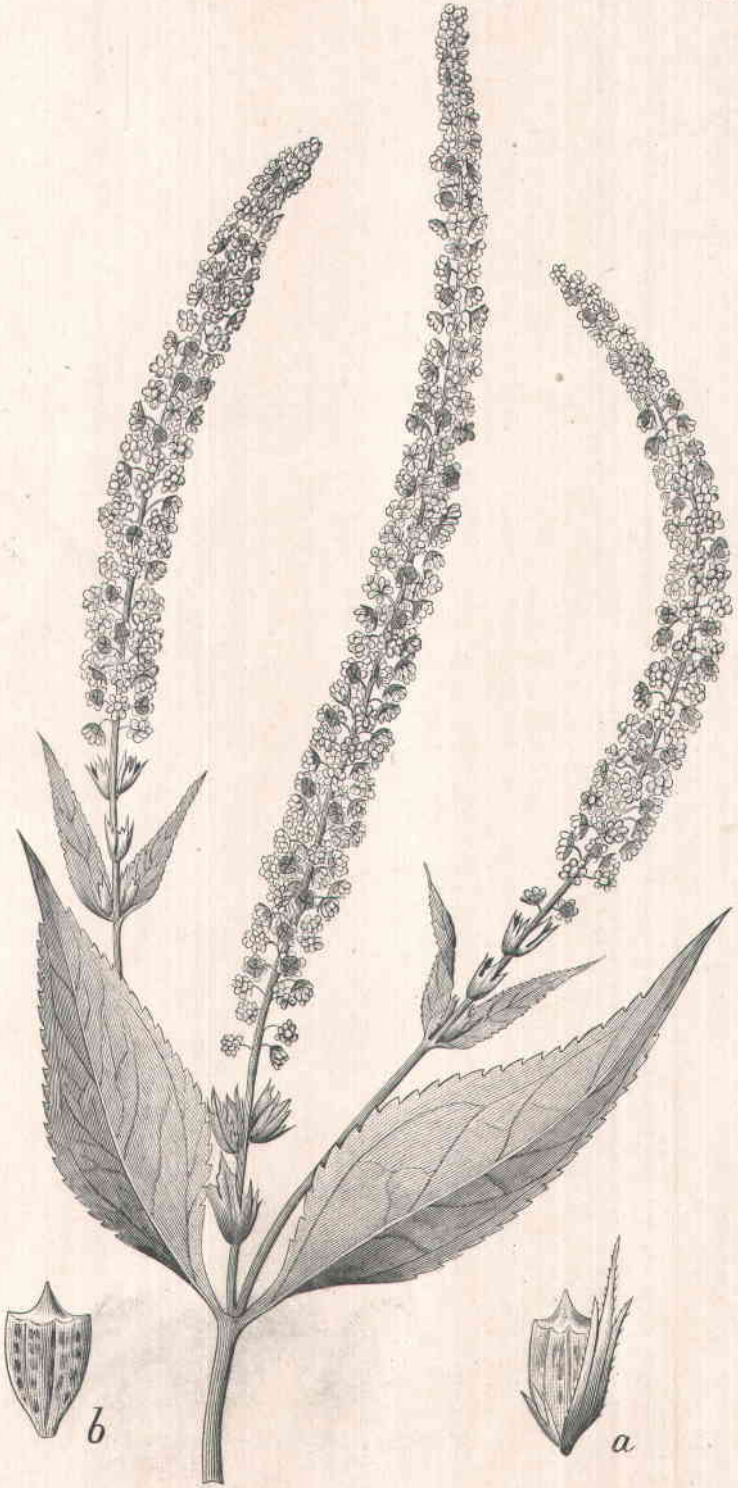
[Plate VIII.]

An annual grass growing to the height of 2 or 3 feet. The stem is rather weak and branching, the large top when in fruit bending over gracefully. The panicle is large and diffuse, the branches fine and much subdivided, the spikelets small, several flowered, and on slender pedicels.

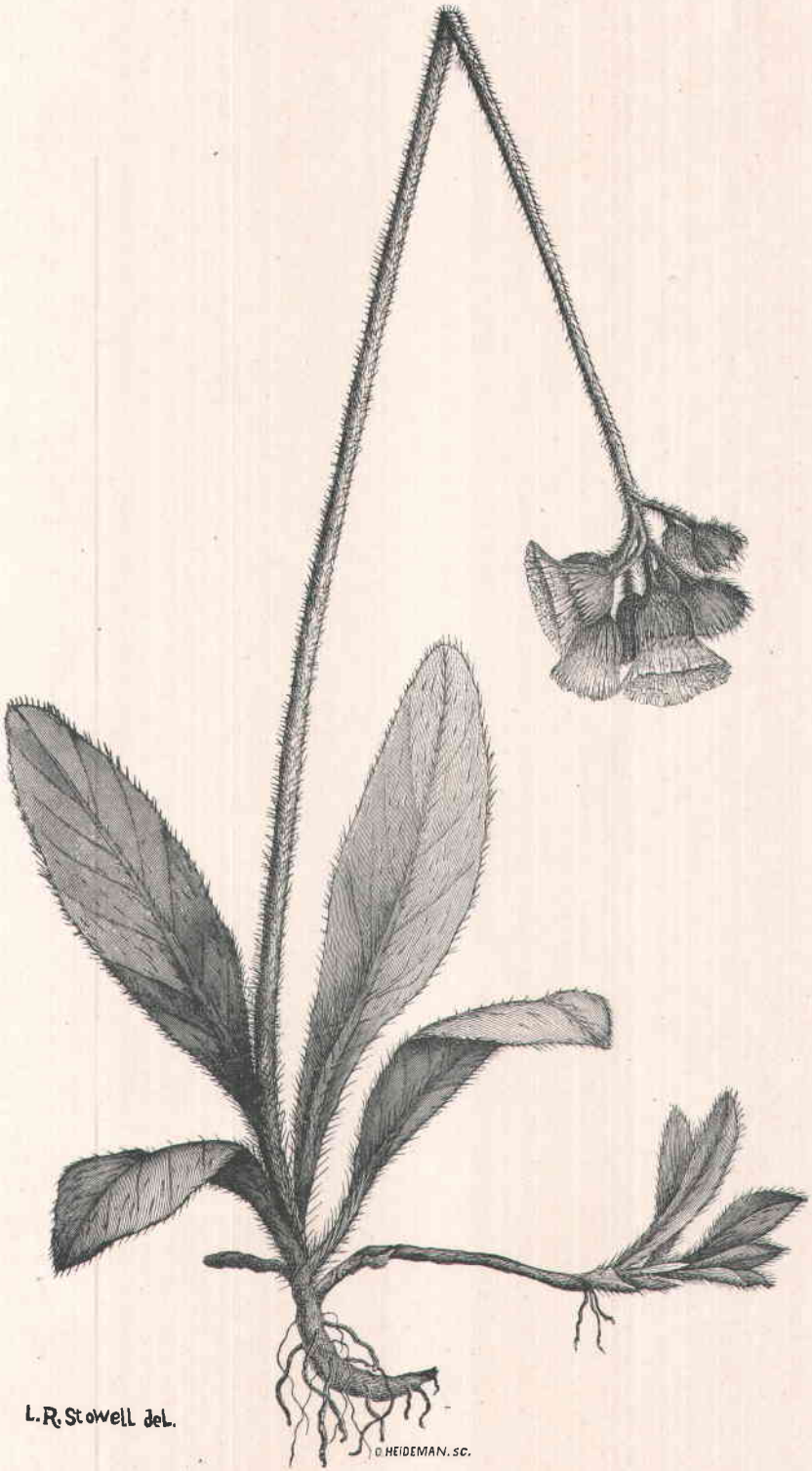
This grass was introduced from Abyssinia, where it is cultivated under the name of Teff, and is used by the natives as food. It has been cultivated in some of the Southern States, and is said to be remarkably productive and valuable for hay. It may be cultivated at altitudes of 6,000 to 7,000 feet, where maize can hardly thrive. It is said to mature in four months and to yield forty times its weight of seed. The traveler, Bruce, mentioned Teff with approval. It is said to make a white, delicious bread. The seed has been diffused by the Royal Botanic Garden of Kew, England, and recently by this Department to several of the Experiment Stations, where it is undergoing a trial.

LIST OF PLATES

REPORT OF THE BOTANIST.

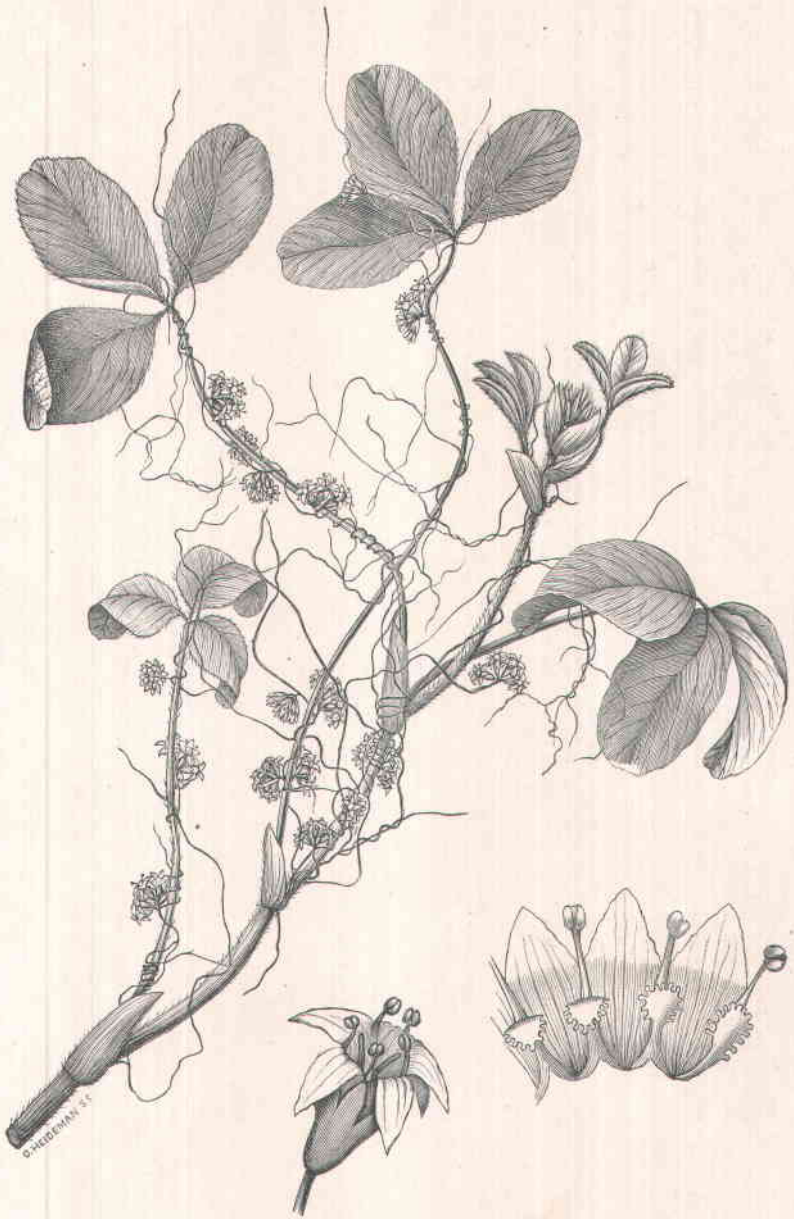


HORSE WEED (AMBROSIA TRIFIDA).



ORANGE HAWKWEED (HIERACIUM AURANTIACUM).

TOAD FLAX (LINARIA VULGARIS).

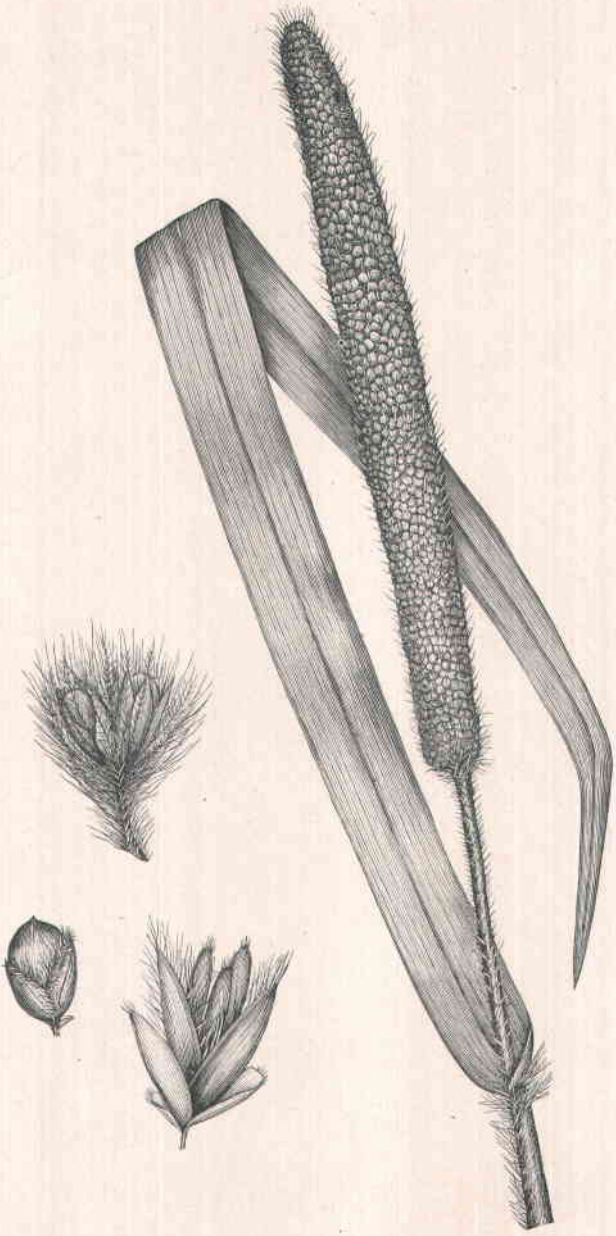


L. R. Stowell del.

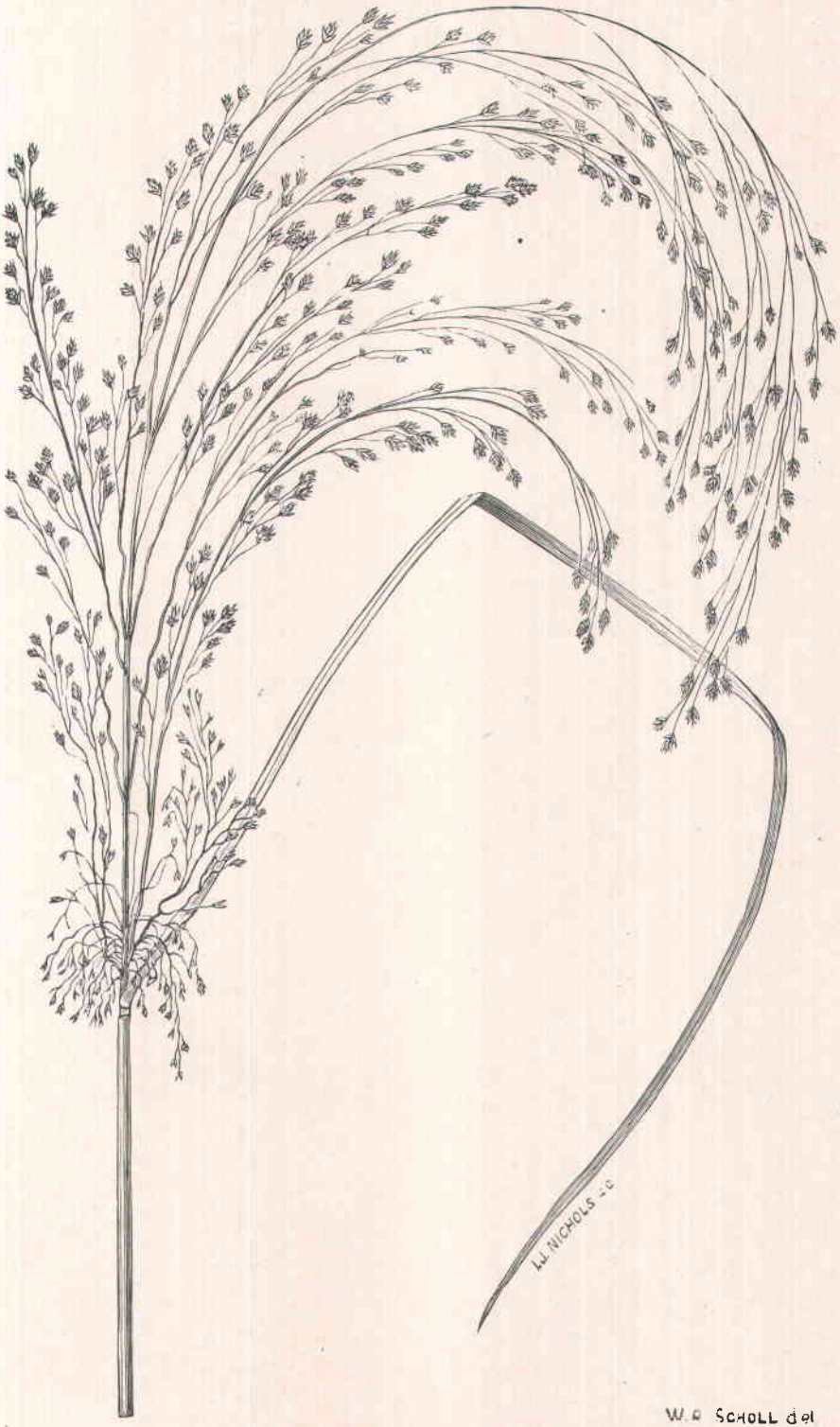
CLOVER DODDER (CUSCUTA TRIFOLII).

ENGLISH PLANTAIN (PLANTAGO LANCEOLATA).

BUR GRASS (CENCHRUS TRIBULOIDES).



PEARL MILLET (PENNISETUM TYPHOIDEUM).



TEFF (ERAGROSTIS ABYSSINICA).