STRAIGHTENING SAWS.

In the manufacture of saws, the straightening forms a large proportion of the manipulative processes. The cutting of the teeth, the grinding, the polishing, the tempering, and the finishing: each of these processes is accompanied by a straightening operation; for in insuring an equal amount of tension at all parts of the blade lies one of the principal elements necessary to the production of a good saw, and a blade can hardly have any mechanical operation performed upon it without affecting its tension and straightness. In the use of saws, it is found that band and frame saws are, under ordinary conditions, comparatively easily kept true and straight; whereas hand and circular saws are readily affected by several causes, among which the most prominent is the setting of the teeth. The blades of circular saws, moreover, frequently become hot, and the heating of a blade is almost certain to impair its straightness, and hence the equilibrium of its tension.

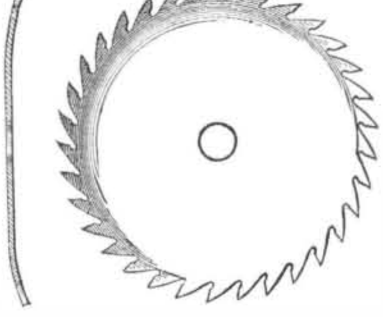
The set of a saw tooth should all be given to the tooth itself, and in no case should it extend below the bottom of the tooth into the solid blade; because in that case it affects the straightness of the same and renders it liable to break. The harder any cutting tool is, the more cutting duty it will perform without becoming dull. On the other hand, the strength depends upon the degree of hardness or temper. In a saw, the temper is made to conform to the requirements of strength and elasticity, the latter element including its resistance to becoming bent or taking a permanent set, if bent much out of the straight line; and this degree of temper (which is shown by a blue color) is found to be the highest which it is practicable to give to the saw teeth: which, being formed out of the plate itself, are necessarily of the same temper as the plate. Furthermore, the blue shows the highest temper which it is practicable to give to the teeth, and still allow them the capability of being bent to obtain the set. Indeed, it is only from the fact of their being weakened by the spaces between them that they will permit of being set without becoming broken; for were we to attempt to set the solid edge of a plate or blade, it would break, if properly tempered. If then, in setting saw teeth, we allow the setting to extend below the tooth, the strength of the latter is destroyed, and the straightness of the plate or blade is impaired.

What is commonly called a buckle or a bend in a saw plate is known to the trade as a tight or a loose place, meaning that the want of straightness is produced by parts of the blade being unduly contracted or expanded; and all the efforts of the straightener are directed to the end of removing the contraction or of accommodating the expansion, so that, the unequal tension or strain being removed, the plate will be true and straight. If we take a saw plate that is quite true, and lay it upon a truly planed iron plate and allow it to become first heated and then cooled thereon, we shall find that it has become warped by the process, and it is apparent that the warping has been produced by the expansion and contraction of the plate, and possibly mainly from irregular heating and cooling; for it is impossible to insure that the heat can be imparted to and extracted from the plate equally in all parts. The varying widths, the extra exposure of the teeth due to their partial isolation (and hence their increased susceptibility to heat and cold), and other elements, would all cause inequalities in heating, against which it would be impossible to provide. The circular saw affords the best example of the vicissitudes caused by unequal tension, as well as the most striking instance of the minuteness and skill in mechanical detail required in the saw straightener's art.

Suppose, for example, that we have a circular saw of three feet diameter, and that it is made straight and true, and with an equal degree of tension existing all over it. Let its circumference travel at a speed of 2,500 feet per minute: it is obvious that the centrifugal force generated by the motion will tend (and actually does, to a slight extent) to expand the saw plate, and it is equally obvious that this expansion decreases in amount as the center of the saw is approached. The equality of the tension on the plate is destroyed; and though stiff and true when in a state of rest, the saw is loose on the outside (or, in other words, center-bound) when rotated, the looseness of the plate decreasing from the circumference towards the center as the radius shortens. As a consequence the extreme edge will, when in motion, flop over from one side to the other, according to the side on which the duty offers the most resistance; and this resistance will vary, from the curves in the grain in the wood, from knots, and from a variety of more minute causes. It follows, then, that the sawing cannot be smooth, and that, as the saw bends or flops over on one side, the opposite side of the blade will come into close contact with the work, entailing friction and, as a result, heating; the latter will cause the saw to dish, and to remain permanently dished.

The method employed by the saw straightener to compensate for the expansion due to the centrifugal motion is to place upon the saw a tension insufficient to dish the saw when at rest, and yet sufficient to accommodate the expansion due to the centrifugal force. This he does by the delivery of blows upon the plate, the effect of which will be to create a tension sufficient to tend to enlarge the plate without overcoming the resistance to enlargement offered by the plate itself until such time as the centrifugal force diminishes this resistance: when the tension follows up the advantage afforded by the centrifugal force, and holds the plate from becoming loose on its outer circumference. If from an error of judgment the tension is insufficient to accommodate the centrifugal force, the saw becomes loose in the middle, or, in other words, it becomes rim-bound when in motion; and the result is that it dishes, as shown in Fig. 1. So that one side contacts with the work; and if the saw teeth meet with different resistances on its two sides (which may occur from the waves in the grain of the timber, or from other causes), the dish will jump from one side to the other of the saw, because, from being rim-bound, it is impossible that it remain straight. And as soon as it is forced over the straight line, it springs to the dished form, which is the only one capable of accommodating the tension. Now when it is remembered that cutting out the metal to form the teeth weakens the saw, rendering it more susceptible to expansion from the centrifugal force, and that the number and the depth of the teeth, and the temper, thickness, and size of the saw, as well as the speed at which it rotates, are all elements tending to vary the force and effect of the centrifugal motion, it will be readily perceived that it requires unusual judgment and skillful manipulation to enable the workman to give to a saw the exact amount of tension called for by the particular circumstances under which it is to operate. Yet so skillful are some of the straighteners that they have been known to remedy a defect in a saw from the delivery of a single light blow.

Fig. 1.



The blows delivered are in no case quick ones, nor are they sufficient to leave an indentation or impression upon the saw blade or plate. Each is given with a view either to create or remove tension, and not to give to the metal a permanent set; and although in explaining the method of manipulation it will be necessary to show, in the illustrations, the hammer marks, it is to be understood that those marks are not visible upon the work, and are only employed to denote where the blows were delivered.

In Figs. 2 and 3 are shown the hammers used by the saw straighteners. The first is called a "doghead." Its weight is about 3 lbs., its diameter is about 1¾ inches, and its length is about 5½ inches. Its handle which is about 14 inches long, stands at an angle of 85° to the body of the hammer. Its face is round-ing, and of an even sweep. That shown in Fig. 3 is called a blocking hammer; the face at A is slightly rounded. In Figs. 4 and 5 are presented the straightening blocks; that shown in Fig. 4 is of iron faced with steel. The face is bright, smooth, and slightly rounded. Fig. 5 represents a wooden block upon which the straightening of the finished saws is performed.

Fig. 2.

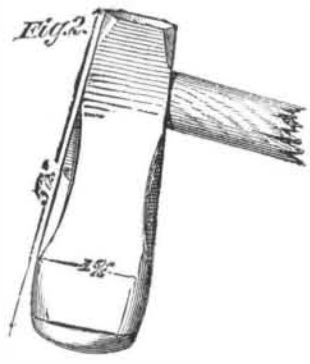
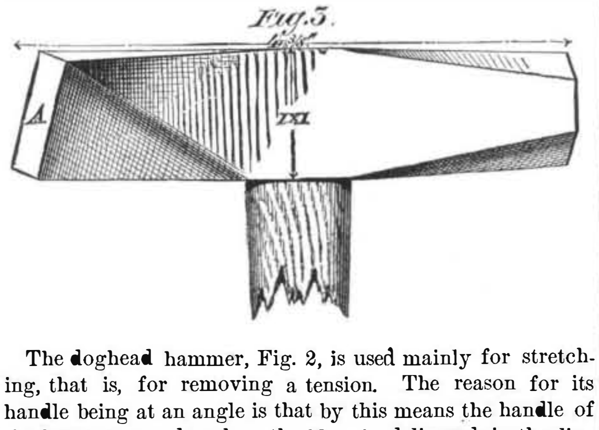
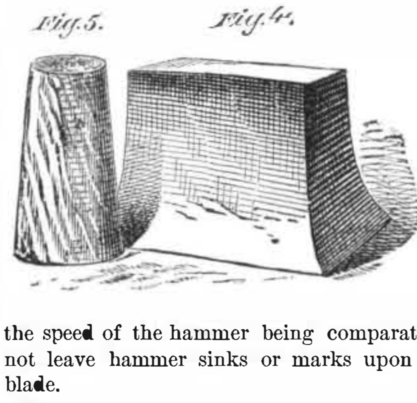


Fig. 3.



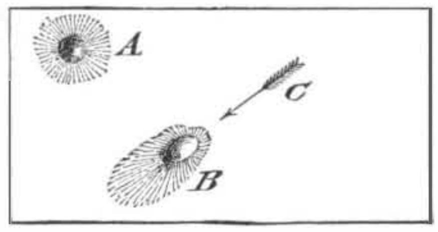
The doghead hammer, Fig. 2, is used mainly for stretching, that is, for removing a tension. The reason for its handle being at an angle is that by this means the handle of the hammer stands, when the blow is delivered, in the line of the hammer's motion; hence the blow delivered is a dead one, that is to say, it has as little spring or rebound as possible. By this means the effect produced by the blow is kept at a maximum; and the speed of the hammer being comparatively slow, it does not leave hammer sinks or marks upon the saw plate or blade.

Fig. 5. Fig. 4.



The part of the saw plate being operated upon must always be kept flat upon the anvil, so that the blows will be received on a solid: otherwise they would distort the blade by bending it instead of stretching it. The motion of the doghead hammer, shown in Fig. 2, is sometimes such that it strikes the plate or blade fair, so that its effects extend equally in all directions, as shown in Fig. 6, at A, in which the dark center shows where the hammer fell, and the radiating lines denote the stretching effects of the blow. At other times, the direction in which the hammer falls is aslant, as shown in Fig 6, at B, in which the hammer, while falling, travels also in the direction denoted by the arrow, C, the stretching effects of the blow being denoted by the radial lines around the center, at B. The motion of the hammer, however, is never varied so as to travel towards, but always away from, the operator, the saw (if not a circular one) being turned end for end upon the straightening block when necessary.

Fig. 6.



The method of using the blocking hammer, shown in Fig. 3, is as follows: The shape of the face of the hammer, in conjunction with the line of motion in which it falls, determine the direction in which the effects of the blow shall extend. If, for example, the face, A, of the blocking hammer were flat, and the blow fell vertically true, the effect of the blow would radiate equally on all sides of the spot which received the blow. If, however, the face, A, of the blocking hammer, while falling, traveled also laterally, the effects of the blow will be greatest on the side towards which the lateral travel took place. Thus, in Fig. 7, if the hammer, in falling, traveled from B towards the hammer mark shown, the effect of the blow would be as denoted by the radial lines; while if the position of the hammer face were turned to a right angle, and a blow were struck with the hammer traveling laterally from C towards the hammer mark shown, the effects upon the plate would be in the direction denoted by the radial lines, shown at C. The curve of the face of the blocking hammer, at A, also has an influence in extending the effects of the blow forward; and the result of these combined elements is that the blows lift the plate in front of them, so that, if blows were delivered as shown in Fig. 8, at A, the plate would bend upwards, assuming the shape denoted by the dotted lines at that end: while by blows delivered in the direction indicated by the marks at B, the plate or blade would curl up, as shown by the dotted lines at that corner of the plate.

Fig. 7.

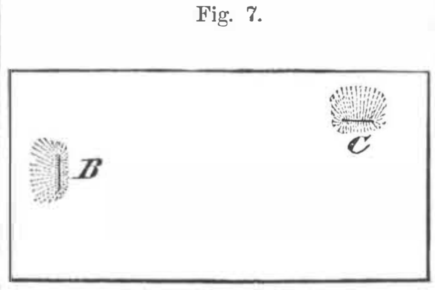
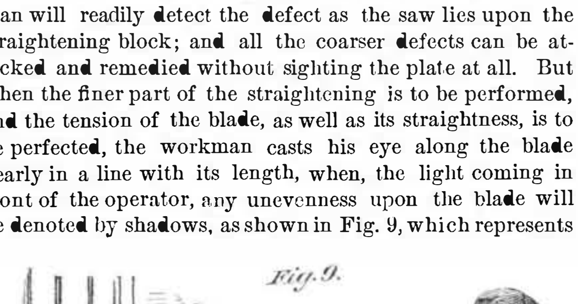
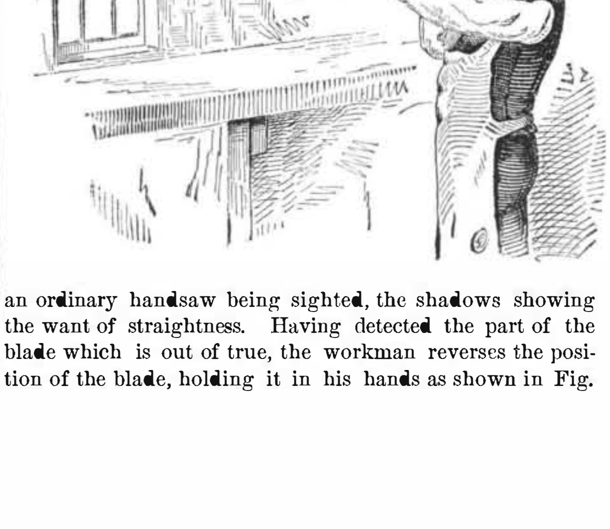


Fig. 8.



A saw plate or blade may have a bend in it that is not discernible to the unpractised eye; and yet the expert workman will readily detect the defect as the saw lies upon the straightening block; and all the coarser defects can be attacked and remedied without sighting the plate at all. But when the finer part of the straightening is to be performed, and the tension of the blade, as well as its straightness, is to be perfected, the workman casts his eye along the blade nearly in a line with its length, when, the light coming in front of the operator, any unevenness upon the blade will be denoted by shadows, as shown in Fig. 9, which represents an ordinary handsaw being sighted, the shadows showing the want of straightness. Having detected the part of the blade which is out of true, the workman reverses the position of the blade, holding it in his hands as shown in Fig.

Fig. 9.



10, and he then bends the plate slightly backwards and forwards, the object of which is as follows: The defects in the

Fig. 10.

plate exist by reason of some part being either unduly expanded or contracted, thus creating undue local tension in one place, and removing the natural tension in another. The workman, when bending the plate backward and forward, finds that the loose place (or, in other words, the expanded part) moves easily, while the contracted part offers a resistance to the bending movement; so that, by noticing the amount of the movement during the bending, the workman discovers where the contracted part is, and he proceeds to remove it by stretching the blade in that spot. Thus while straightening the blade its tension is also equalized, giving to the plate a uniform resistance to its becoming bent or sprung. During the hammering process, the straight edge is frequently applied to the blade as a guide to test the work by. If, while attacking the necessary places, the saw blade does not lie solid upon the straightening block, the hammer will drum, as it is called; and the effect of the blow will be to stretch the outside skin of the saw blade, causing it to rise up because of its being elongated. Thus, were the blade to be hammered all over one face without bedding solid on the block, it would become bow-shaped, the face struck being the convex side.

In Fig. 11 is shown a saw blade having a loose place in the

Fig. 11.

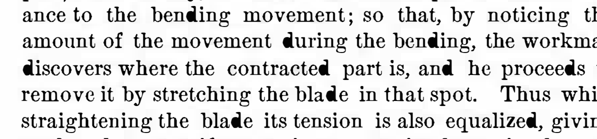
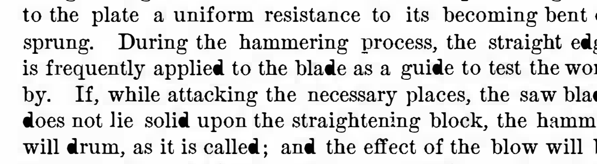


Fig. 12.



middle, as denoted by the shade shown upon the face. The method of attack here would be to deliver the blows denoted by the marks shown at A and B, using the doghead hammer for the purpose. The parts so struck would be stretched, giving room for the loose place to flatten, and taking the undue tension from the outer surface and imparting it to the loose place, the saw becoming slightly elongated by the process. If, however, the bending process or test showed the contraction to be in the middle of the blade, the doghead would be used to deliver the blows shown in Fig. 12, at A, which would stretch the metal there, removing the contraction and equalizing the tension. Suppose, however, that the saw was atwist, as shown in Fig 13: the method of attack

Fig. 13.

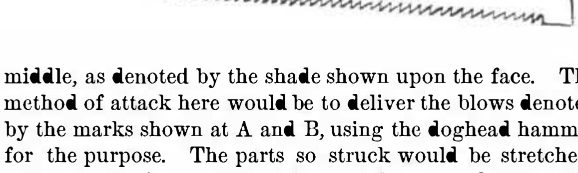
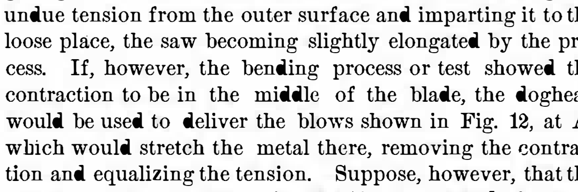


Fig. 14.



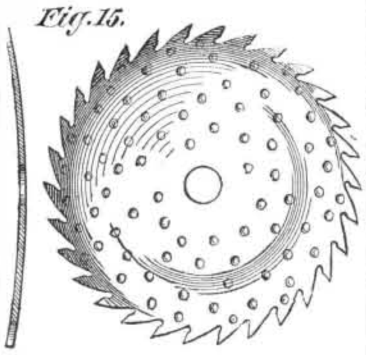
would be to take the blocking hammer, and deliver the blows denoted by the marks shown, using the hammer so that, while falling, it would travel laterally slightly from the workman. The blade would be placed upon the block with the drooping side downwards, because the effect of the blows of the blocking hammer is, as before noted, to lift the plate in front of them.

If one edge of the saw blade had a kink or wave in it, as shown in Fig. 14, the method of procedure would be as follows: The blade would be placed upon the block with the hollow side of the kink downwards, as shown in Fig. 14, and the blows shown at A would be delivered. The effect of these blows will be to stretch the metal of the plate, removing the tension behind the kink, and producing a tension tending to lift the part kinked. The plate is then turned upside down, and the blows denoted by the marks shown in Fig. 14, at B, are delivered, which will remove the kink.

In performing any one of these operations new contractions or expansions of parts may be induced; and it not unfrequently happens that a kink and a twist, or a twist and a loose place, may be attacked at the same time. Numerous combinations of contracted or expanded places may of course exist in a blade, and the process for removing one may be modified or carried on in conjunction with that necessary to remove another; the principles employed, however, are in all cases those explained above, the application being varied to suit the circumstances.

In the edge view of Fig. 15 is shown a circular saw dished; and here it may be noted, that in this case as well as when the saw is out of straight, the first thing to do is to get the dish out, and afterwards proceed with the straightening. To remove the dish, the saw is placed upon the block with the concave side uppermost; and the blows are delivered with the doghead in the places denoted by the marks shown on the face view of the saw in Fig. 15. The testing of the saw is made by bending it, by sighting it, and by applying a straight edge to its surface. Some circular saws are too thick and strong to be easily bent, and in that case the bending test is omitted. If a circular saw is atwist or has a kink in it, the method of attack is the same as that already described for similar defects in hand or frame saws: except that, as before explained, a slight tension is left upon the outer diameter so as to allow for the expansion of the saw created by the centrifugal motion and force. J. R.

Fig. 15.



Communications.

Our Washington Correspondence.

To the Editor of the Scientific American :

The letter of the Commissioner of Patents to the Secretary of the Interior on the general management of the Patent Office has been followed by a meeting of the different heads of bureaus of the Interior Department, for a general interchange and comparison of views and a discussion of the reports submitted by them upon the subject of civil service reform as applicable to the department. General Spear earnestly advocated the system of competitive examination, which prevailed in the Patent Office for several years before it was ignored by Secretary Chandler from the failure of Congress to provide means of paying the Civil Service Commission. It is to be hoped that competitive examination will again be the rule in making appointments, instead of the question as to a man's usefulness as a politician, as the examinations formerly made undoubtedly led to a great improvement in the examining corps during the time the system was in force. But in forming a new set of rules to govern the competitive examinations, should this system be adopted, those who will have the matter in charge should see that the questions asked the applicants have some connection with the duties they will be called on to perform. Under the old Civil Service Commission a large proportion of the queries asked would not have the least possible connection with Patent Office business, such, for instance, as geographical, historical, and astronomical questions, that would have been very proper if put to applicants for pedagogueships, but which could not, when answered correctly, give any indication as to the answerer's knowledge of mechanics or patent law. Such questions as these could be readily answered by young men just fresh from school; while old Patent Office examiners, who had learned these things in their youth, but in the course of acquiring the requisite knowledge of the classes of inventions under their charge had forgotten them, had, consequently, to take back seats, and see beardless youths who did not possess a tithe of their technical knowledge, and who in some cases actually knew nothing of the classes to which they were appointed, pass over their heads to higher positions.

Bids were to have been opened to-day at the Post Office department for supplying postal cards for four years from the first of May next. The advertisement required the bids to be for cards conformable to the sample furnished by the department, and this sample was one with different tints to the two faces—a buff and a pale green. A number of the leading paper manufacturers having represented to the Postmaster-General that this would virtually establish a monopoly in bidding, as but two or three manufacturers had the machinery necessary for this kind of paper, and that the result would be that the department would be compelled to pay a larger amount for the cards, the Postmaster-General decided to reject all bids, and to call for new proposals for a card such as can be made by any first class paper maker.

The Agricultural Department is continually troubled with applications for seed; but its distribution has ceased for the season, except to those districts of the West which were afflicted by grasshoppers in 1876, and for which a special appropriation was made by Congress a short time before the close of the session. Applications from other sections cannot therefore be responded to, and parties outside of the grasshopper districts will save time and trouble by not making application.

Congress last session appropriated $18,000 for the purpose of sending a commission to investigate the grasshopper plague, and suggest remedies for the relief of the suffering farmers whose crops have been yearly devastated by this rapacious insect. The President has appointed Professor C. V. Riley, State Entomologist of Missouri; Professor Cyrus Thomas, Entomologist of Illinois; and Professor Packard, of Salem, Mass., as the Commission. This action is the result of a conference held in Nebraska by the Governors and prominent men of the States and Territories interested, in which Professors Riley and Thomas each took a prominent part. The commission is an excellent one, and will probably make a report of great value. They propose to go as far west as the breeding places of the insect, and study its habits, and from them deduce a plan for its destruction, if possible. The Southern farmers are reported as grumbling at the neglect of their section, and ask: If the grasshopper is to be investigated, why should not the habits of the tobacco or cotton worm be examined by a commission also? They think they have as much right to a commission as the Western agriculturists.

Washington, D. C. OCCASIONAL.

[For the Scientific American.]

IMPORTANT OBSERVATIONS ON THE ROCKY MOUNTAIN LOCUST, OR "GRASSHOPPER" PEST OF THE WEST.

BY PROFESSOR C. V. RILEY.

In a few weeks the ravages of the Rocky Mountain locust (*caloptenus spretus*) will, in all probability, be creating more attention than ever, as the area threatened by the young insects is larger than ever before, beginning in Southeastern Dakota, including the Southwestern half of Minnesota, the Western half of Iowa, 4 counties in Northwest and 12 in Southwest Missouri, Benton County in Arkansas, Texas from that point to the mouth of the Sabine river, thence along the Gulf to Austin, and more or less all the country west of these points to the mountains. In view of this probability, the following observations, which are largely extracted from my ninth report, now going through the press, and which are here recorded for the first time, will doubtless prove of interest to your large circle of readers: I propose to follow them with the results of a series of experiments on the eggs and the young insects, with a view of most effectually destroying them, which experiments these observations will render more intelligible.

DOES THE FEMALE FORM MORE THAN ONE EGG MASS?

Whether the female of our Rocky Mountain locust lays her full supply of eggs at once, and in one and the same hole, or whether she forms several pods at different periods, are questions often asked, but which have never been fully and definitely answered in entomological works. It is the rule with insects, particularly with the large number of injurious species belonging to the *lepidoptera*, that the eggs in the ovaries develop almost simultaneously, and that when oviposition once commences it is continued uninterruptedly until the supply of eggs is exhausted. Yet there are many notable exceptions to the rule among injurious species, as in the cases of the common plum curculio and the Colorado potato beetle, which oviposit at stated or irregular intervals during several weeks or even months. The Rocky Mountain locust belongs to this last category; and the most casual examination of the ovaries in a female taken in the act of ovipositing will show that, besides the fully formed eggs being then and there laid, there are other sets, diminishing in size, which are to be laid at future periods. This, I repeat, can be determined by any one who will take the trouble to examine a few females when laying. But just how often, or how many eggs each one lays, is more difficult to determine. With *spretus*, I have been able to make comparatively few experiments, but on three different occasions I obtained two pods from single females, laid at intervals of 18, 21, and 26 days respectively. I have, however, made extended experiments with its close congeners, *femur rubrum* and *Atlanis*, and in two cases with the former have obtained four different pods from one female, the laying covering periods of 58 and 62 days, and the total number of eggs laid being in one case 96, and in the other 110. A number of both species laid three times, but most of them—owing perhaps to their being confined—laid but twice. They couple with the male between each period, and I have no doubt but that, as in most other species of animals, there is great difference in the degree of individual prolificacy.

I have frequently counted upward of a hundred ova in the ovaries of *spretus*, and as the largest and most perfect pods seldom contain more than thirty, we may feel confident that the Rocky Mountain locust will sometimes form as many as four pods, and perhaps even still more.

The time required for drilling the hole and completing the pod will vary according to the season and the temperature. During the latter part of October, or early in November last year, when there was frost at night and the insects did not rouse from their chilled inactivity till 9 o'clock A.M., the females scarce had time to complete the process during the four or five warmer hours of the day; but with higher temperature not more than two or three hours would be required.

HOW THE EGGS ARE LAID.

The question as to how best to treat the soil, or to manage the eggs so as to most easily destroy their vitality, is a most