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.

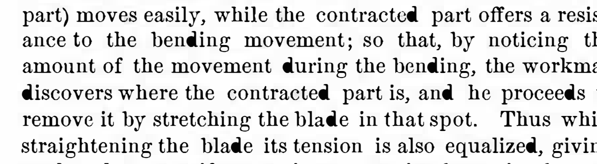
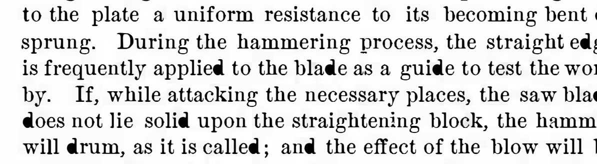


Fig. 12.



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.

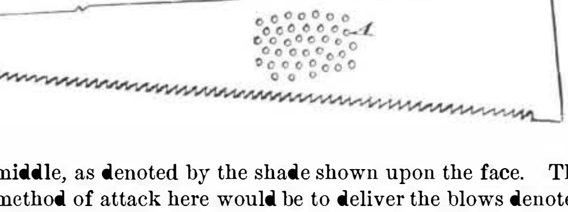
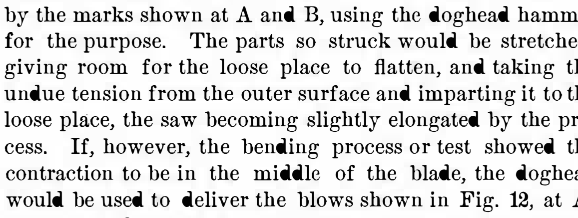


Fig. 14.



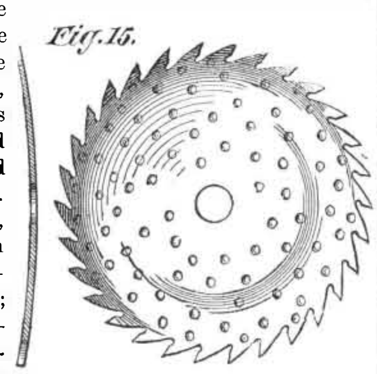
would be to take the blocking hammer, and deliver the blows denoted by the marks shown, using the hammer so that, while falling, it would travel laterally slightly from the workman. The blade would be placed upon the block with the drooping side downwards, because the effect of the blows of the blocking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

Fig. 15.



J. R.

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.

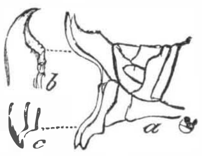
The time required for drilling the hole and completing the pod will vary according to the season and the temperature. During the latter part of October, or early in November last year, when there was frost at night and the insects did not rouse from their chilled inactivity till 9 o'clock A.M., the females 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 important and practical one; and as assisting to a decisive answer, I have carried on a series of experiments which will be presently detailed. To make the experiments the more intelligible, I will first give the reader a deeper insight into the philosophy of the processes of egg-laying and of hatching than I have hitherto done, and this the more readily that it has never been given by any other author.

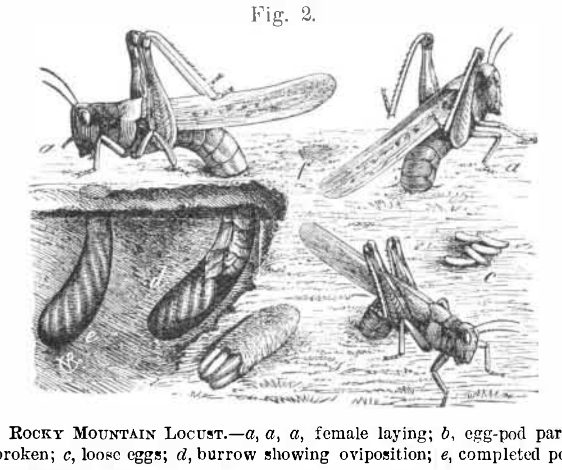
I have already explained (Report VII, page 122) how, by means of the horny valves at the end of her abdomen (Fig. 1), the female drills a cylindrical hole in the ground in which to consign her eggs. The curved abdomen stretches to its utmost for this purpose, and the hole is generally a little curved and is always more or less oblique. (Fig. 2, *e d*.) If we could manage to watch a female during the arduous work of ovipositing, we should find that, when the hole is once drilled, there commences to exude at the dorsal end of the abdomen, from

Fig. 1.



ROCKY MOUNTAIN LOCUST: Anal character of female, showing horny valves.

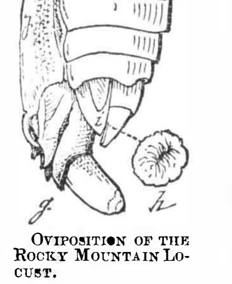
Fig. 2.



ROCKY MOUNTAIN LOCUST.—*a*, *a*, *a*, female laying; *b*, egg-pod partly broken; *c*, loose eggs; *d*, burrow showing oviposition; *e*, completed pod; *f*, covering to one.

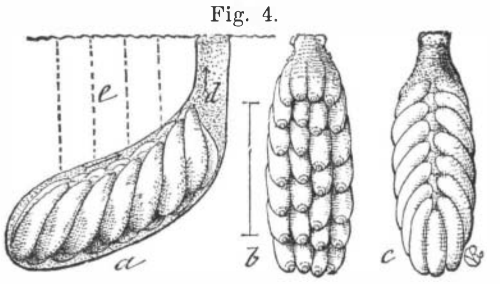
a pair of sponge-like exsertile organs (Fig. 3, *h*) that are normally retracted and hidden beneath the super-anal plate near the cerci (Fig. 3, *i*), a frothy mucous matter, which fills up the bottom of the hole. Then, with the two pairs of valves brought close together, an egg would be seen to slip down the oviduct (*j*) along the ventral end of the abdomen, and, guided by a little, finger like style (*g*), pass in between the horny valves (which are admirably constructed, not only for drilling, but for holding and conducting the egg to its appropriate place), and issue at their tips amid the mucous fluid already spoken of. Then follows a period of convulsions, during which more mucous material is elaborated, until the whole end of the body is bathed in it—when another egg passes down and is placed in position. These alternate processes continue until the full complement of eggs are in place, the number ranging from 20 to 35, but averaging about 28. The mucous matter binds all the eggs in a mass, and when the last is laid, the mother devotes some time to filling up the somewhat narrower neck of the burrow with a compact and cellulose mass of the some material, which, though light and easily penetrated, is more or less impervious to water, and forms a very excellent protection. (Fig. 4, *d*.)

Fig. 3.



OVIPOSITION OF THE ROCKY MOUNTAIN LOCUST.

Fig. 4.

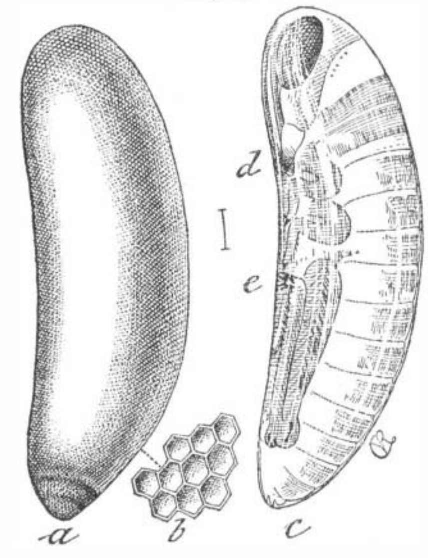


EGG MASS OF ROCKY MOUNTAIN LOCUST.—*a*, from side; *b*, from beneath; *c*, from above—enlarged.

PHILOSOPHY OF THE EGG MASS.

To the casual observer the eggs of our locust appear to be thrust indiscriminately in the hole made for their reception. A more careful study of the egg mass or egg pod will show, however, that the female took great pains to arrange them, not only so as to economize as much space as possible consistent with the form of each egg, but so as to best facilitate the escape of the young locust; for as the bottom eggs were the first laid, and are generally the first to hatch, their issue would, in their efforts to escape, disturb and injure the other eggs, were there no provision against such a possibility. The eggs are, indeed, most carefully placed side by side in four rows, each row generally containing seven. They oblique a little crosswise of the cylinder. (Fig. 4, *a*.) The posterior or narrow end which issues first from the oviduct is thickened and generally shows two pale rings around the darker tip (Fig. 5, *a*). This is pushed close against the bottom of the burrow, which, being cylindrical, does not permit the outer or two side rows to be pushed quite as far down as the two inner ones; and for the very same reason the upper or head ends of the outer rows are necessarily bent to the same extent over the inner rows—the eggs when laid being somewhat soft and plastic. There is, consequently, an

Fig. 5.



EGG OF ROCKY MOUNTAIN LOCUST.—*a*, sculpture of outer shell; *b*, same more enlarged; *c*, with the outer shell removed, just before hatching; *d e*, points where the shell is ruptured.

irregular channel along the top of the mass (Fig. 4, *c*) which is filled only with the same frothy matter which surrounds each egg, and occupies all the space in the burrow not occupied by the eggs. The whole plan is seen at once by a reference to Fig. 4, which represents, enlarged, a side view of the mass within the burrow (*a*) and a bottom (*b*) and top (*c*) view of the same, with the earth which adheres to it removed.

HOW THE YOUNG LOCUST ESCAPES FROM THE EGG.

Carefully examined, the egg shell is found to consist of two layers. The outer layer, which is thin, semi-opaque, and gives the pale cream-yellow color, is seen, by aid of a high magnifying power, to be densely, minutely, and shallowly pitted; or, to use still more exact language, the whole surface is netted with minute and more or less irregular, hexagonal ridges (Fig. 5, *a*, *b*). The inner layer is thicker, of a deeper yellow, and perfectly smooth. It is also translucent, so that, as the hatching period approaches, the form and members of the embryon may be distinctly discerned through it. The outer covering is more easily ruptured and is rendered all the more fragile by freezing; but the inner covering is so very tough that a very strong pressure between one's thumb and finger is required to burst it. How, then, will the embryon, which fills it so completely that there is scarcely room for motion, succeed in escaping from such a prison? The rigid shell of the bird's egg is easily cracked by the beak of its tenant; the hatching caterpillar, curled within its egg shell, has room enough to move its jaws and eat its way out; the egg coverings of many insects are so delicate and frail that the mere swelling of the embryon affords means of escape; those of others so constructed that a door flies open or a lid lifts up by a spring, whenever pressure is brought to bear; in some, two halves open, as in the shell of a muscle; whilst in a host of others the embryon is furnished with a special structure, called the egg burster, the office of which is to cut or rupture the shell, and thus liberate its occupant. But our young locust is deprived of all such contrivances, and must use another mode of exit from its tough and subelastic prison. Nature accomplishes the same end in many different ways. She is rich in contrivances. Every one who has been troubled by it must have noticed that the shanks (tibiæ) of our locust, as of all the members of its family, are armed with spines. On the four anterior legs these spines are inside the shank; on the long, posterior legs, outside. The spines of the hind shanks are strongest, and the terminal ones, on all legs, stronger than the rest. There can be no doubt that these spines serve to give a firm hold to the insect in walking or jumping; but they have first served a more important pre-natal purpose.

When fully formed, the embryon is seen to lie within its shell, as at Fig. 5, *c*. The antennæ curve over the face and between the jaws, which are early developed, and with their sharp black teeth, reach on to the breast. The legs are folded up on the breast, the strong terminal hooks on the hind shanks reaching toward the mesosternum.

Now, the hatching consists of a series of undulating contractions and expansions of the several joints of the body, and with this motion there is slight but constant friction of the tips of the jaws and of the sharp tips of the tibial spines, as also of the tarsal claws of all the legs, against the shell, which eventually weakens between the points *d* and *e*, and finally gives way there. It then easily splits to the eyes or beyond, by the swelling of the head. By the same undulating movements the nascent larva soon works itself entirely out of the egg, when it easily makes its way along the channel already described without in the least interfering with the other eggs, and finally forces a passage way up through the mucous filling in the neck of the burrow. (Fig. 4, *d*.) Once fully escaped from the soil, it rests from its exertions, but for a short time only. Its task is by no means complete: before it can feed or move with alacrity, it must molt a pellicle which completely incases every part of the body. This it does in the course of three or four minutes, or even less, by a continuance of the same contracting and expanding movements which freed it from the earth, and which now burst the skin on the back of the head. The body is then gradually worked from its delicate covering until the last of the hind legs is free, and the exuvium remains, generally near the point where the animal issued from the ground, as a little, white, crumpled pellet. Pale and colorless at first, the full-born insect assumes its dark gray coloring in the course of half an hour. From this account of the hatching process, we can readily understand why the female in ovipositing prefers compact or hard soil to that which is loose. The harder and less yielding the walls of the burrow, the easier will the young locust crowd its way out.

The covering which envelops the little animal when first it issues from the shell, though quite delicate, undoubtedly affords protection in the struggles of birth from the burrow; and it is an interesting fact that, while it is shed within a few minutes of the time when the animal reaches the free air, it is seldom shed if, from one cause or other, there is failure to escape from the soil, though the young locust may be struggling for days to effect an escape.

While yet enveloped in this pellicle, the young animal possesses great forcing and pushing power, and, if the soil be not too compact, will frequently force a direct passage through the same to the surface, as indicated at the dotted lines, Fig. 4, *e*. But it can make little or no headway, except through the appropriate channel (*d*), where the soil is at all compressed. While crowding its way out, the antennæ and four front legs are held in much the same position as within the egg, the hind legs being generally stretched. But the members bend in every conceivable way, and where several are endeavoring to work through any particular passage, the amount of squeezing and crowding they will endure is remarkable. Yet if, by chance, the protecting pellicle is worked off before issuing from the ground, the animal loses all power of further forcing its way out.

THE BRITISH IRONCLAD ALEXANDRA.

On page 258, we present a fine sectional view of a vessel that is now one of the strongest in the English navy. Judging by the past history of ironclad ships, in a very few years hence the Alexandra will be deemed weak, or else withdrawn from service altogether, adding another to the long list of armored vessels which have been set aside as useless because of the progress made in the construction of artillery capable of perforating their plates. Even now the heavy Krupp guns and the 100-ton English cannon not only pierce 12-inch iron plating, which is the thickest carried by the Alexandra, but send their bolts through two plates of that thickness separated by 9 inches of solid oak. It will be seen, therefore, that against such weapons the sides of the Alexandra offer little resistance, and that the ship before such artillery is practically as vulnerable as a wooden frigate. Nor are there any vessels now afloat which can oppose the shot of the 100-ton gun successfully. The Inflexible, now the most powerful of British ironclads, has 24 inches of plating, and the Dandolo and Duilio, new Italian ironclads, nearly the same; yet the recent trials of the great cannon above mentioned, at Spezzia, show that targets representing sections of these vessels were quickly destroyed. The ironclad of the near future must carry either the 40-inch plates which Sheffield makers have promised to roll, or else be incased in steel; for steel armor, it now appears, has offered the best resistance to the shot of the 100-ton gun. The thickest armor of the Alexandra, the belt at her water line, is the 12-inch plating referred to. About her batteries the iron is only 8 and 5 inches thick, so that the men at the guns and the guns themselves are virtually unprotected against shot from modern artillery of even moderate weight.

Though laboring under a great disadvantage in point of vulnerability, the Alexandra embodies some of the newest and most important improvements in naval construction. She is a central battery ship, and is able to train four guns, including the two heaviest of her armament of twelve, straight ahead and two straight astern. This capability is of the greatest moment, since the vessel thus has a range of fire around the entire horizon.

The section of the ship given in our engraving is taken through the battery, showing the two gun decks. The sills of the ports of the lower deck are 9 feet, and those of the upper deck ports 17 feet above the water. The guns are of the Fraser pattern, and are constructed of steel tubes surrounded by coils of wrought iron increasing in number and thickness toward the breech. There are two 25-ton and ten 18-ton guns. The Alexandra is an ocean-going cruiser, and is now flagship of the British Mediterranean squadron. Her dimensions, etc., are as follows: Length between perpendiculars, 225 feet; extreme breadth, 63 feet 8 inches; depth of hold, 18 feet 7⅝ inches; tonnage, 6,049; displacement, 9,492 tons; draught forward, 26 feet; indicated horse power, 8,000; speed per measured mile, 16 knots.

A MARBLE statue of Sir William Fairbairn has now been completed. The statue, which is to stand in the new Town Hall, Manchester, England, is eight feet high, and represents Sir William standing with papers in his hand as if delivering an address to a scientific audience; the head is bare and slightly inclined, and the statue is an admirable likeness, in the features as well as in the thoughtful expression and quiet energy characteristic of the man.

STATISTICS show that about 250,000 barrels of apples were exported from America last year to Europe. More than half this quantity was sent to England, and about 11,000 barrels went to St. Petersburgh.