[From the Fourth Annual Report of Charles V. Riley, State Entomologist of Missouri.]

THE CECROPIA SILKWORM.

Attacus [Platysamia] Cecropia, Lin.—(Lepidoptera, Bombycidæ.)

The Cecropia silkworm is common, and its great size and beauty attract general attention. It is also more easily obtained, for the cabinet, than most of our other large moths, because its cocoon is always fastened to a twig where it remains all winter, a conspicuous object. The ground color of the wings is a grizzled dusky brown with the hinder margins clay yellow; near the middle of each of the wings there is an opaque kidney shaped white spot, shaded more or less on the outside with dull red, and edged with black; a wavy dull red band, edged inside with white, crosses each of the wings, and the front wings next to the shoulders are dull red with a curved white and black band, and have near their tips an eye like a black spot with a bluish white crescent: the upper side of the body and legs are dull red; the forepart of the thorax and the hinder edges of the rings of the abdomen are white, and the venter is checkered with red and white. There is considerable variation in the ground color of individuals, some being quite dark and others quite light, but the female differs from the male in nothing but her larger abdomen and much smaller antennæ or feelers.

The genus *attacus*—meaning elegant—was founded by Linnæus, and our moth received its specific name from the same author.

During the winter time, the large cocoons of this insect (Fig. 2) may be found attached to the twigs of a variety of trees. I have found them upon the apple, cherry, currant, barberry, hazel, plum, hickory, blackberry, elderberry, elder, elm, lilac, red root, maple, willow, and honey-locust. It has also been found on the pear. This cocoon tapers both ways, and is invariably fastened longitudinally to the twig; it is formed of two distinct layers, the outer one, which is loose, wrinkled, and resembles strong brown paper, covering an inner oval cocoon composed of the same kind of silk, but closely woven like that of the mulberry silkworm.

FIG. 2.—Cocoon of the Cecropia.

Inside of this cocoon will be found a large brown chrysalis.

In the month of May, in the latitude of St. Louis, and earlier or later the further north or south we go, our Cecropia moth issues from its cocoon, and there can be no more beautiful sight imagined than one of these gigantic fresh born moths with all its parts soft and resplendent. The uninitiated would marvel how such an immense creature had escaped from the small cocoon which remains at its side, retaining the same form which it always had, and showing no hole through which the moth could escape. The operation—so interesting and instructive—can be witnessed by any one who will take the trouble to collect a few of the cocoons and place them in some receptacle which has sufficiently rough sides to admit of the moth's crawling up, to hang its heavy body and wings while they dry and expand. The caterpillar has the wonderful foresight to spin the upper or anterior end of its cocoon very loosely; and when the moth is about to issue, it is still further aided in its efforts by a fluid secreted during the last few days of the chrysalis state, and which is a dissolvent of the gum which so firmly unites the fibers of the cocoon. This fluid is secreted from two glands, which open into the mouth, and as soon as the chrysalis skin is split open on the back, by the restless movements of the moth within, the fluid flows from the mouth and wets the end of the cocoon, dissolving the gum and softening the silk to such an extent that, by repeated contractions and extensions of the body, the moth is at last enabled to separate the fibers, and to thrust out its head and unbend its front legs; after which it rapidly draws out the rest of its body, the mouth of the cocoon afterwards closing by the natural elasticity of the silk. At this moment the body of the moth is much swollen and elongated, the wings are small, folded, and pad-like, and the whole insect is soft and moist; but, attaching itself to the first object at hand where it can hang its heavy body and clumsy wings, the latter become expanded in about twenty minutes, and the superabundant fluids of the body sufficiently evaporate in a few hours to enable the insect to take wing.

The eggs of the Cecropia moth are 0·09 inch long, sub-oval, flattened, and of a pale cream color, shaded with light brown;

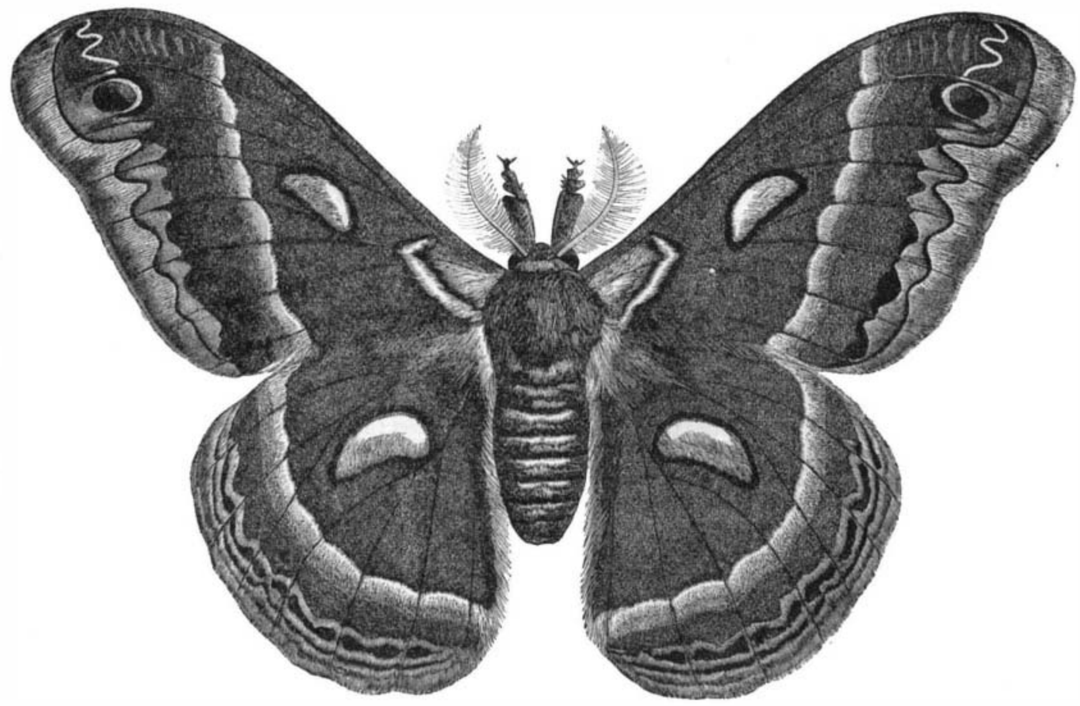


FIG. 1.—THE CECROPIA MOTH, MALE.

and they are deposited in small patches on the plants which are to form the food of the future larvæ. They are deposited in June, and hatch in from six to ten days thereafter.

When first hatched they are entirely black, with the tubercles placed in the same position; but are larger at the base and with a narrower stem than in the more mature individuals, the upper and smaller end being crowned with a whorl of conspicuous stiff black bristles. After the first molt, the body is of a deep orange color, with the tubercles and head

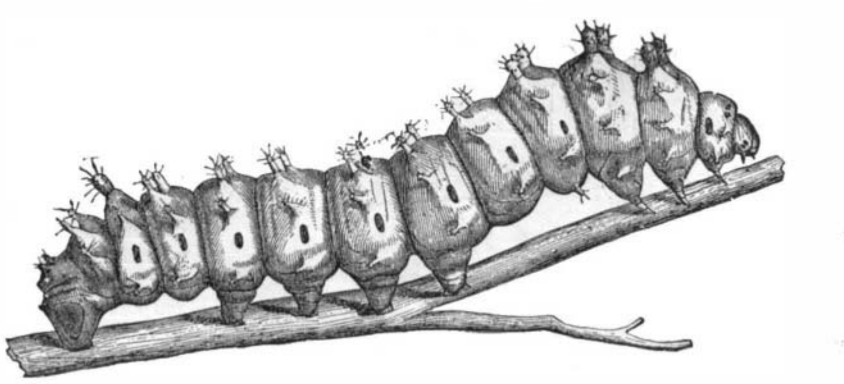


FIG. 3.—THE CECROPIA SILKWORM.

black, and with longitudinal rows of black dots running between them. After the second molt, a still greater change takes place; the body acquires a beautiful yellowish green tint, the tubercles on the back are blue on joints 1, 12, and 13, coral red on 2 and 3, and yellow with black spines, with a black spot on the inside and outside of the stem, on 4—11; those at the sides are blue, and the head is of the same color as the body. After the third molt, the black spots, except a row below the stigmatal row of tubercles, disappear; the tubercles themselves lose all black except the spines, and the head and body become delicate bluish green rather than yellowish green, as formerly. After the fourth and last molt, the red tubercles near the head frequently become yellow, and when full grown, the worm measures over four inches, and presents the appearance shown in our engraving (Fig. 3), the tubercles being respectively of the most delicate yellow and blue.

Two weeks after the worm first begins to spin, it changes to a chrysalis, and, as already stated, passes the winter in this form, there being but one brood each year.

The cocoon of this insect is often found to contain a kernel of corn, a grain of wheat, or even an acorn; and the first time I found a corn kernel in one of them, I was sorely puzzled to comprehend how it came there, and imagined that it must have been accidentally dropped, by some bird, into the meshes of the cocoon while the latter was being formed. But the kernels are found in the cocoons altogether too frequently to admit of any such chance coincidence, which must necessarily be of very rare occurrence. There is every reason to believe, therefore, that these foreign materials are placed there, for safe keeping, by some bird; the loose end of the cocoon admitting of their being forced in, even after it is completed. Dr. LeBaron thinks that this bird is very likely the blue jay, which is known to have the habit, in common with other *corvidæ*, of pilfering and hiding in holes and crevices any small object that attracts its attention. One of my correspondents from Geneva, Ill., who has found no less than five of these cocoons containing kernels of corn, thinks the chickadee (*parus atricapillus*, L.) uses them as a storehouse, as well as the blue jay, and, indeed, inclines to believe that the former is the sole proprietor. He has seen it, with corn in bill, searching about apple trees for such a storehouse, and has witnessed it deposit a kernel in the crack of a board fence.

The Cecropia worm, as may be inferred from its size, is an immense feeder, and a small number will soon defoliate a young apple tree. It has, on a few occasions, been found numerous enough to do injury in this way; but as a rule, natural enemies keep it so thoroughly in check that it can hardly be classed as an injurious insect. The same may be said of the other large and native worms which I include with the silkworms, and which on account of their silk-producing qualities may with propriety be treated of rather as beneficial insects, though their products have not yet been utilized. Their great size and conspicuity not only renders them a ready prey to their natural enemies, but enable us to easily destroy them by hand picking whenever they happen to become unduly multiplied on any of our fruit trees.

PARASITES OF THE CECROPIA SILKWORM.

THE LONG-TAILED OPHION.—(*Ophion macrurum*, Linn.)—This large yellowish brown ichneumon fly (Fig. 4) is often bred from the cocoons in place of the moth which one expects. It is one of the most common parasites of this large insect, and the females appear to be altogether more common than the males. The female, according to Mr. Trouvelot, deposits from eight to ten eggs upon the skin of her victim, and the young larvæ soon hatch from them and commence to prey upon the fatty parts of the worm. But as only one of the parasitic larvæ can find food sufficient to mature, the rest all die from hunger, or else are devoured by the strongest one which survives them.

After the Cecropia worm has formed its cocoon, the parasitic larva, which had hitherto fed on the fatty portions of its victim, now attacks the vital parts, and, when nothing but the empty skin of the worm is left, spins its own cocoon, which is oblong oval, dark brown, inclining to bronze, and spun so closely and compactly that the inner layers, when separated have the appearance of goldbeater's skin. If we cut open one of these cocoons soon after it is completed, we shall find inside a large fat legless grub (Fig. 5), which sometimes undergoes its transformations and issues as a fly in the fall, but more generally waits till the following spring.

FIG. 4.—Ophion.

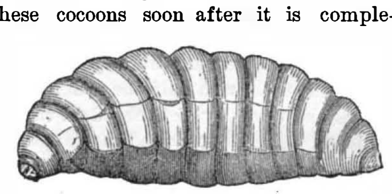


FIG. 5.—Grub of the Ophion.

THE CECROPIA TACHINA FLY.—(*Exorista leucaniæ*, Kirk. var. *cecropiæ*, Riley.)—The ichneumon fly last mentioned usually causes a dwarfed appearance of the worm which it infests, and parasitized cocoons can generally be distinguished from healthy ones by their smaller size. The larvæ of this tachina fly, which is also parasitic on the Cecropia worm, seem to produce an exactly opposite effect, namely, an undue and unnatural growth of their victim. This fly differs only from the army worm tachina fly (*exorista militaris*, Walsh) in lacking the red tail entirely, or in having but the faintest trace of it, and I consider it but a variety of that species.

THE MARY CHALCIS FLY—(*Chalcis mariæ*, Riley).—I received from Mr. V. T. Chambers, of Covington, Ky., numerous specimens of the beautiful large chalcis fly figured herewith (Fig. 6), which he had taken from the cocoon of the Polyphemus moth, which is quite common, and issues as early as the middle of February in that locality. He says, "I was satisfied that the cocoon did not contain a living Poly-

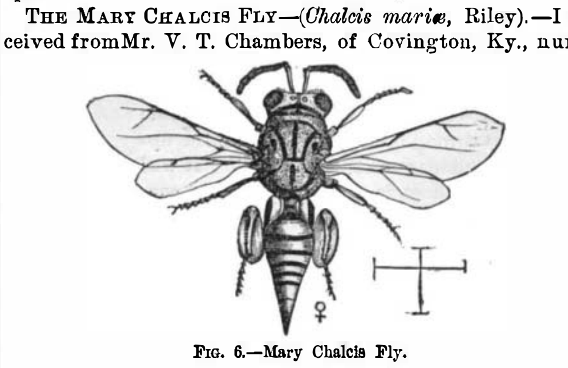


FIG. 6.—Mary Chalcis Fly.

phemus, and therefore opened it. It contained so little besides these insects and their exuviæ as to suggest strongly the old idea that the caterpillar had been metamorphosed into them (as in a sense it had). There were forty-seven of them, of which twenty-three were females. As all the males and some of the females were dead when I opened the cocoon, I think it likely that the former never do emerge, and perhaps few of the latter, otherwise Polyphemus would soon be exterminated."

I can very well imagine that most of these chalcis flies would die in their efforts to escape from the tough cocoon of the Polyphemus, but it so happens that these same parasites have been found by Mrs. Mary Treat, of Vineland, N. J., to prey upon the Cecropia worm, from the cocoon of which they can more easily escape.

This fly is of a yellow color, marked, as in the engraving, with black.

THE CECROPIA CRYPTUS—(*Cryptus extra,matis*, Cresson).—Another ichneumon fly (Fig. 7) often infests the Cecropia worm, the larvæ filling its cocoon so full of their own thin

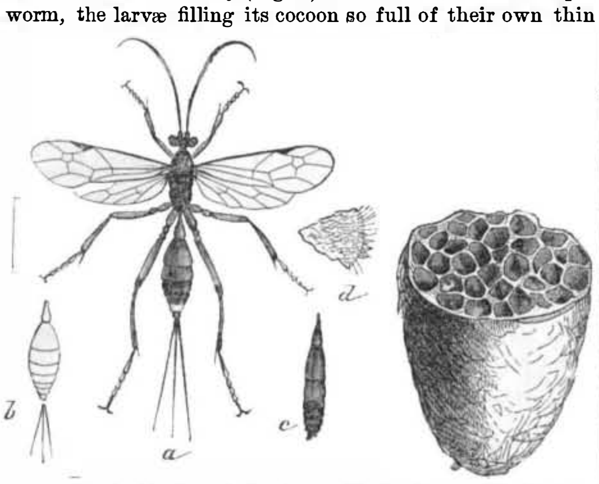


Fig. 8.—The Cecropia Cryptus. Fig. 9.—Cocoons of the Cryptus.

parchment-like cocoons, that a traverse section (shown in Fig. 8) bearsconsiderable resemblance to a honeycomb. The flies issue in June. The wings have a smoky appearance, caused, as may be seen when viewed under a microscope, by innumerablelittlehooks regularly arranged over their surface.

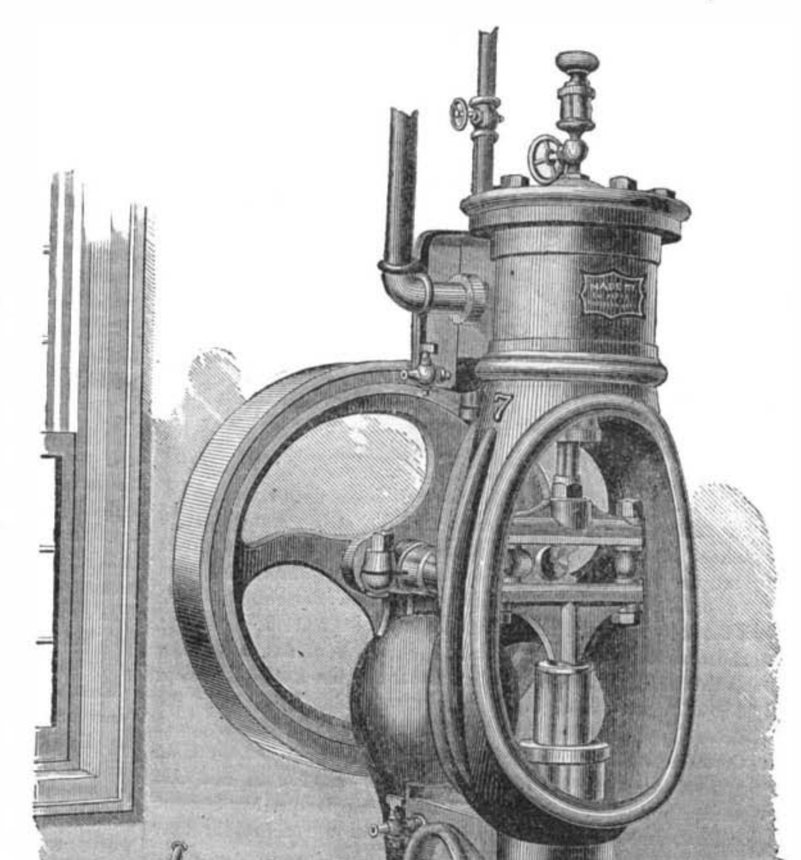
DOUBLE-ACTING BUCKET PLUNGER STEAM PUMP.

The fire pump illustrated in our engraving is of a form and manufacture doubtless already familiar to many of the readers of our journal. It is therefore not a new invention, but rather one which, during the three years that it has been before the public, has been made, from time to time, the subject of useful improvements; so that, in presenting it now, it is desired not merely to call attention to the advantages claimed for its peculiar mode, but also to the success which it has encountered from the period of its introduction.

The points to be noted consist in the arrangement of the bucket plunger and its method of operation. About the steam cylinder and valve there is nothing peculiar, unless it is the entire absence of complicated valve gear. The bucket plunger is composed of two cast iron cylinders, the larger one being below and packed with composition packing rings. The water cylinder in which it operates is made twice the area, in comparison to the steam cylinders, of the ordinary forms of double-acting steam pumps, the object being, it is stated, to dispense with half the number of water valves, as the quantity discharged on the upward stroke is, as will be explained hereafter, thrown out through an opening in the top of the pump cylinder, and does not pass through the valve opening. Water is drawn in, on the up stroke, through a suction valve near the bottom of the cylinder, filling the latter. The downward stroke forces the contents out through the discharge valve, one half the quantity passing into the air chamber, and the other half flowing up into a passage and thence into the upper part of the cylinder encasing the small part of the plunger. The reason that one half of the water is forced out is that the small part of the plunger takes up that proportion of the interior space of the cylinder. On the next upward stroke, the water around the plunger is forced out through a passage and into the air chamber, thus filling up the pump, the same stroke replenishing the cylinder as before. Thus, it is stated that, after the pump has made a few strokes, a steady stream is kept up, as the quantity of water taken into the cylinder through the suction valve on the up stroke is just double that forced out through the passage from the upper end of the cylinder on the same stroke. It will be observed that there is another reason for constructing water cylinders in the proportions above noted, from the fact that, while a large portion of power is required to discharge water, but little is needed to draw it through the suction valves.

The fly wheel is operated by a crank, sliding block and cross head; to the latter, the steam piston and bucket plunger are attached by their piston rods. The pump barrel and steam cylinders are in line with each other.

The working advantages are claimed to be ready taking of water, facility of running with greatest rapidity without jarring or thumping, and strength and durability in material and construction. Pumps of this description have been exhibited at the recent Fairs of the American Institute in this city, one of them receiving a medal and being rated first in order of merit at the exhibition of 1870. Numerous testimonials as to the successful operation of the device, from many leading firms, are also submitted by the makers. Patented by Mr. William Wright, of New York, March 8, 1870. For further particulars, address the manufacturers, the Valley Machine Company, Easthampton, Mass.



WRIGHT'S DOUBLE-ACTING BUCKET PLUNGER STEAM PUMP.

Lake Okeechobee.

This is the Indian name of a large lake in the southern part of the peninsula of Florida, distant 45 miles inland from Jupiter Inlet on the Atlantic coast, and 200 miles south of St. Augustine. The lake is 65 miles long and 30 miles wide, surrounded by extensive marshes which render it difficult of approach, and hence but little is known of its precise character. It contains several large islands, which we believe have never been carefully explored. A recent number of the New York *Herald* contains an account of a visit to this great lake by G. K. Allen, of San Marie, Florida, and four companions. It was with extreme difficulty that they made their way through the swamps and over quicksands, but they finally gained the edge of a bayou which floated them to the lake; and once upon its bosom, no further obstacles to progress were encountered.

From the first two or three miles out from the shore, they were terribly annoyed by mosquitoes and flies of various kinds, from which they could only in part protect themselves by thick veils over faces and hands. But at eight miles distance, the insects were no longer troublesome. Three miles from the shore they found shallow water—five feet—and sundry low islands inhabited by immense alligators. At a distance of eighteen miles from the shore, the water became clear and bottom was found at 170 feet. Here they discovered a group of three islands; the largest about six miles long, and four miles wide. The northern portion of this island was a barren, rocky waste, which extended back from the shore nearly a mile and a half, to the base of a line of rocky cliffs, about one hundred and fifty feet high, which extended across the whole width of the island. To the south of these cliffs is a magnificent forest, composed chiefly of large mahogany, palmetto and laurel magnolia. Many of the latter trees, being in full bloom, presented an enchanting scene. This forest extends over the whole of the southern portion of the island, except to within a few hundred yards of the shore, which at every point is sandy and covered with rocks.

The island next in size is about one fourth of a mile west of this large island; it is about four miles long and a mile and a half wide, and is covered by a forest like that on the large island. The third is quite small, being only about one mile long and from a half to three quarters of a mile wide. Very few animals of any kind, and none of a savage nature, were found upon these islands.

In the forests spiders of a gigantic species were found. One was seen which was fully two feet long. It had long and very strong looking limbs, and would have weighed three or four pounds. In its head, which was jet black, were several eyes, each surrounded by a bright yellow and scarlet circle. The body was encircled by bands of scarlet, yellow and black. Altogether the spider presented a very brilliant appearance

Upon the largest island, north of the cliffs, the explorers were surprised to find heaps of stones, lying in such a position as to resemble ruins of some kind of structures. None of the ruins were extensive, and the structures must, therefore, have been of small dimensions. Similar ruins, if such they were, were found in great numbers upon the small island, north of this one. Upon the summit of a cliff which stands upon the eastern shore of the large island, the party found a large heap of stones lying in a semicircular form, and facing to the east.

The length of these ruins was nearly two hundred feet. In front of this semicircle, and about fifty feet from it, was a large heap of stones, nearly twenty feet square. The ruins found on the plain below, and upon the small island, were much smaller than those found upon the cliff, being only from five to ten feet square.

One Hundred Miles an Hour.

The highest railway speeds in the world are attained in England, and the highest railway speed in England is attained on the Great Western Railway, and this speed may be taken roundly as fifty miles an hour. There is a tradition in existence that Brunel once traveled from Swindon to London at eighty miles an hour; but we have never been able to obtain a shadow of proof that this speed has been reached under any circumstances or at any time whatever on a railway. Mr. Stirling has run with one of his great outside cylinder express engines and a train of sixteen carriages at seventy miles an hour on the Great Northern, on a level or with a slightly falling gradient; and we know that the Yarmouth express on the Great Eastern sometimes has reached a speed of sixty-four miles an hour down the Brentwood bank. On two occasions, some years ago in Ireland, we ran 14 miles in sixteen minutes with a powerful engine and a train of but two carriages. Much of the run was done at over 65 miles per hour. On the Boston and Albany road, United States, the 54 miles between Springfield and Worcester were run by an engine with 16 inches cylinder, 22 inches stroke, and 6½ feet driving wheel, in fifty-eight minutes.

Much of the run was done at nearly seventy miles an hour. On a first class line there can be no question, therefore, but that a speed of sixty-five to seventy miles an hour may be available with safety. We believe that it would be possible to lay permanent way so well, and to maintain it in such excellent order, that trains might travel on it with perfect safety at 100 miles an hour. Miles upon miles of such track are to be found now on most of our great main lines, but it is not to be disputed that nowhere can 100 consecutive miles of permanent way in perfection be found; and as a chain is no stronger than its weakest link, so a few hundred yards of bad track would spoil for the purpose of traveling at 100 miles an hour a whole line. It would not be impossible, however, to maintain a line of such rails from London to Liverpool or York. The really important question is, given the line and the carriages fit for it, what shall the engine be like, and is it possible to construct an engine at all which, with a moderately heavy train, will attain and maintain a velocity of 100 miles an hour, on a line with no grade heavier than, say, 1 in 300. The first points to be settled are, how much power can a locomotive of a given size develope, and how much power shall we require to haul a train which will suffice to satisfy the demand of that portion of the public wishing to travel at 100 miles an hour. At 60 miles an hour on an ordinary line, and making due allowance for contingencies, the resistance to be overcome cannot, according to experiments carefully carried out both in France and in this country, be much under 40 lbs. per tun. At 30 miles an hour the resistance is about 20 lbs. per tun; at 47 miles an hour the resistance reaches 32·5 lbs. If the resistance goes on increasing in this proportion, then the resistance at 100 miles an hour cannot be less than 75 lbs. per tun; but it may be very much more, and it would not, we think, be safe to take it at less than 120 lbs. per tun. Now a speed of 100 miles an hour is 146·5, or in round numbers, 146 feet per second, or 8,800 per minute. This, multiplied by 120 and divided by 33,000, gives, say, 32 horse power. Therefore each tun moved at 100 miles an hour will represent 32 horse power. The "Great Britain" broad gage Great Western engine, with its tender, in running order represents a weight of about 64 tuns, and a heating surface of 2,100 square feet. This engine has indicated over 800 horse power. To run such a machine and a train weighing 35 tuns, or a gross load of 99, or, say, in round numbers 100 tuns, at 100 miles an hour would require 100 × 32, or 3,200 horse power, or just four times more power than the most powerful high speed locomotive that has ever been built could exert. To run the engine, weighing 38 tuns, alone would require a power of 1,216 horses, assuming that the engine resistance was identi-