THE SHUMAN SUN-HEAT ABSORBER.

MOST of the experimenters who have attempted to make direct use of the sun's heat for the production of power have adopted the practice of greatly concentrating the sun's rays and focussing them on to a comparatively small and strong boiler

FIG. 1.—Showing one section of absorber on left, steam main and safety valve in centre, and part of engine on right.

generating steam at a fairly high pressure. Mr. Frank Shuman has used a concentration of only two to one, though in the next plant, which will be materially different (due to certain recommendations of Prof. C. V. Boys, F.R.S.) from the one herein referred to, the concentration will be three to one. The boilers are lamellar, about a yard square, and only about one-quarter inch thick. They are made of thin tinned copper, painted dull black on the outside, with a number of opposed indentations, the tinning holding the two sheets together where these indentations touch.

The boilers are fixed in shallow boxes placed nearly horizontally, and having double glass tops with an air space of one inch between the two sheets of glass. Between the lower sheet of glass and the top of the boiler there is another air space of one inch, and below the boiler an air space of about half an inch; then a sheet of millboard one-quarter inch thick, then two inches of granulated cork, and, lastly, a second sheet of millboard three-eighths of an inch thick forming the bottom of the box. Each such unit is a yard square, but twenty-two of them are constructed side by side in one frame, forming one section, and in the plant tested there were twenty-six such sections, thirteen on each side of the main steam pipe. To the top edge of each unit a silvered glass mirror a yard square is attached making an angle of 120° with the glazing of the unit. To the bottom edge a similar mirror is similarly fixed. The top edges of the mirror are thus six feet apart, while the bottom edges are three feet apart; hence the concentration of two to one.

Along the bottom of each section there is a small pipe for supplying the feed water, while a larger pipe runs along the top edge to collect the steam and convey it to the eight-inch main steam pipe. Each section is supported by, and pivoted to, steel A frames, each with a notched quadrant, so as to enable the section to be inclined at different angles. Herein is another distinct feature of the Shuman sun-heat absorber. Practically all the absorbers using great concentration of the sun's rays have had to be focussed continuously on to the sun, but the absorber now being described needs adjusting only once about every three weeks, the adjustment being such that the rays at noon are perpendicular to the top surface of the boilers.

When experimenting at Philadelphia in July, 1910, with a single unit *and no mirrors*, the maximum temperature I recorded under the lower cover glass was 250° F., and temperatures of over 200° F. were common. Even in the latter cases steam was formed freely, showing that the temperature of the boiler was 212° F.

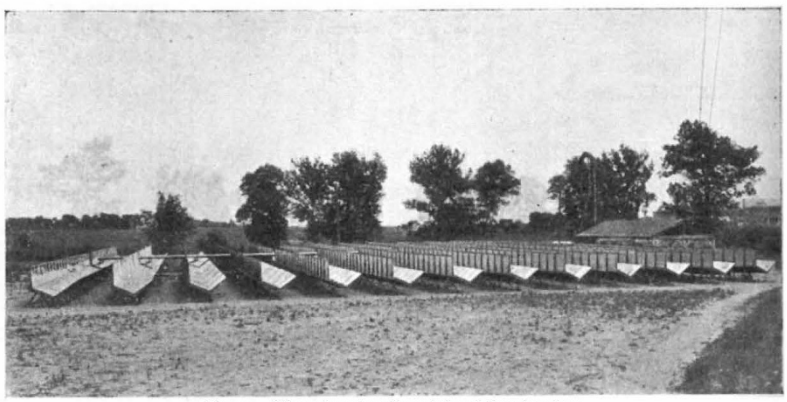


FIG. 2.—View showing the whole of the absorber.

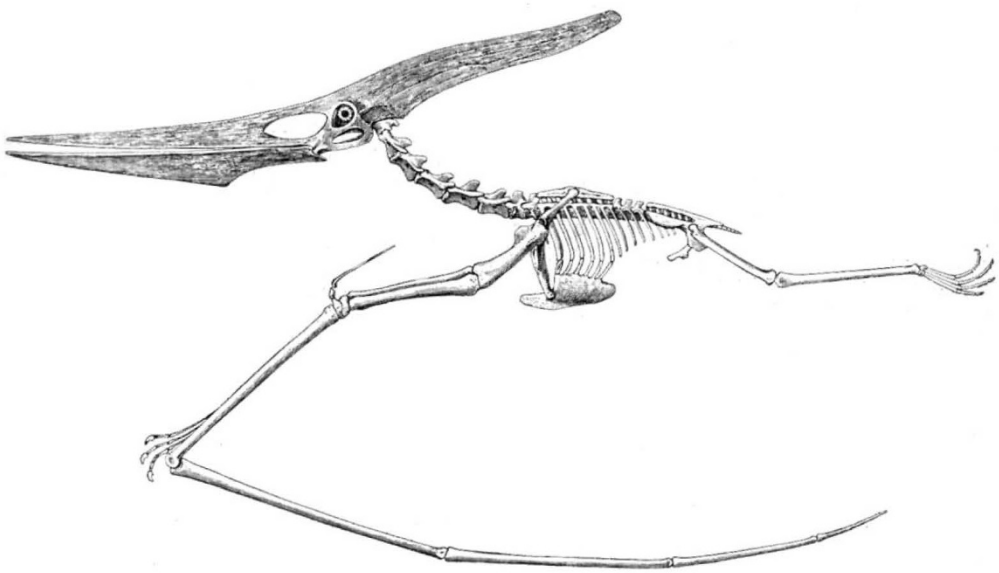
The absorber I tested in August, 1911, had a collecting area of 10,296 square feet, and, with the

necessary gangways, occupied an area of nearly two-fifths of an acre. The maximum quantity of steam produced in any one hour was more than 800 lb. at atmospheric pressure, and while this is by far the greatest quantity ever produced by sun power, it must be pointed out that Philadelphia is by no means an ideal situation for such a plant, for we had to wait weeks to get a nearly cloudless day, and then fortunately had three in succession. 800 lb. of steam per hour is equivalent to a boiler efficiency of 43 per cent. The plant was built at Philadelphia simply for the convenience of being close to the inventor's house, offices, and laboratory. In places like Egypt, Africa, Arizona, and California, I should expect to get about 25 per cent. more steam for the same collecting area.

A. S. E. ACKERMANN.

THE FLYING REPTILES OF THE CHALK PERIOD.[1]

IN the remarkable collection of fossil vertebrates obtained by the late Prof. O. C. Marsh for the Peabody Museum of Yale University, there are many groups of which he only published preliminary notices. Among these the toothless Pterodactyls, which he was the first to discover in the chalk of Kansas, are specially deserving of attention. During the past ten years they have been studied in detail by Dr. George F. Eaton, who has now completed his researches and published a beautifully illustrated memoir, which will be welcomed by palæontologists. So long ago as 1904 Dr. Eaton prepared for the St. Louis Exposition a model of the skeleton of Pteranodon, of which a copy was subsequently given to the British Museum (Natural History), where it is exhibited in the Gallery of Reptiles. In his new work he now reviews the whole of the material which forms the basis of this restoration (shown in the accompanying figure), and his concise descriptions are illustrated not only by admirable photographs of the fossils themselves, but also by explanatory sketches of several of the most important parts.



Restoration of Pteranodon, Marsh; from the left side. For convenience of representation the right limbs are omitted.

Dr. Eaton is, indeed, to be congratulated on the clearness with which his facts and conclusions are presented, and he displays commendable caution in his references to crushed and distorted specimens. The bones are so delicate that nearly all have collapsed by pressure in the laminated chalky rock, and it is therefore often difficult to determine precisely their original shape.

The species of Pteranodon and its allies are the latest and most specialised flying reptiles, and so attain the greatest size. A nearly complete pair of wings mounted in the British Museum (Natural History) measures 18 ft. in span, and Dr. Eaton estimates that some specimens had a span of more than 22 ft. The adaptation of their bones to unusual mechanical needs is therefore of extreme interest. The well-known firm articulation of the scapula with a mass of fused thoracic vertebræ, for the support of the large wings, is now described in detail, and Dr. Eaton thinks there were not more than three separate dorsal vertebræ between this fused mass and the equally rigid sacrum. The tail is very short and small, and the slender hind limbs must have supported the postero-internal borders of the wing-membranes. The elongated jaws of Pteranodon itself are completely toothless, and Dr. Eaton observes that there is never an indication of vestigial tooth-sockets. The articulation for the mandible is obliquely ridged and grooved, so that the two branches would be thrust a little apart when the jaw opened, as in the pelican. It is therefore inferred that the animal was a fish-eater and had a small pouch below the mandible.

In two species, though apparently not in a third, the supraoccipital crest is enormously extended, and would probably serve for the origin of very large temporal muscles giving great snapping power to the jaws. Even for such a purpose the crest appears to be sometimes too large, but Dr. Eaton concludes that it could scarcely be needed as a counterpoise to the long jaws, because "the form of the cervical vertebræ indicates a strong musculature of the upper part of the neck." He alludes to "the general theory that growth along certain lines may be initiated through the exercise of one function, while further development is dependent upon another totally distinct function." The crest may be an illustration of the so-called momentum in evolution.

It will be remembered that many years ago the late Prof. H. G. Seeley devoted much attention to the fragmentary remains of these gigantic specialised Pterodactyls found in the Cambridge greensand, and attained great success in interpreting them. The new work on the better-preserved specimens of Pteranodon from the North American chalk will excite renewed interest in the corresponding English fossils, and facilitate more exact studies of them. A. S. W.

[1] "Osteology of Pteranodon." By Dr. G. F. Eaton. Pp. 38+xxxi plates. Memoirs of the Connecticut Academy of Arts and Sciences, vol. ii. (New Haven, Connecticut: Published under the auspices of the Yale University, 1910.)