which excluded light and air and preserved them while becoming solid, it is analogous to the preservation of plants and insects in gum copal, and does not require unusual arguments to obtain relief. The presence of trees standing upright where they grew and imbedded in coal suggested a probability of immersion in the same way. The recent discoveries of immense deposits of petroleum in subterranean cavities or streams suggests the theory which is here offered—that this "mineral oil," as it was at first called, may be the origin of coal and not its product. Note the thickness of many strata of coal—some are sixty feet thick and are of uniform structure—with slate limestone floors and roofs; and coal also has stratification closely resembling stratified rocks which deserves attention. Petroleum, bitumen, and asphaltum are classed together as of a similar nature, although the first is a liquid and the last named a solid. If these substances are, as we believe, elementary, (of the same class as salt, sulphur, etc.), the solution of this question will be comparatively easy. We find a great difficulty in believing petroleum to be a vegetable product. If any species of vegetation yielded more resinous or oily products in former ages than do those of to-day, these products were either drawn from the earth, water, or air to supply the vegetation that held them. It also seems unreasonable to have so much vegetation derived from the vegetable fiber, when the entire growth of vegetation of any soil or climate appears inadequate to represent a uniform body of coal sixty feet thick.—*Ex.*

STEAM BOILER EFFICIENCY.

The efficiency of a steam boiler is to be measured mainly by its evaporative power and its economy in fuel, and the more widely these two factors diverge—other things being equal—the more perfect the efficiency of the steam generator. It is to the attainment of either or both of these ends that invention is usually directed, although not always with success. Inventive genius, however, is put to the test in the present day by reason of the undoubted tendency of steam engineering practice towards high pressures wherever practicable. In order to attain them various expedients are resorted to, both in the construction of the boiler and furnaces and in the use of auxiliaries, chief among which is forced draught. This latter principle is pushed to its extreme limits in torpedo-boats, in which class of vessels as a result the water evaporation is very low and the consumption of fuel disproportionately high, thus giving a low efficiency from an economical point of view. This will be readily assented to by those who have been present at trial runs of vessels of this class, and who have had to dodge the burning lumps of solid fuel as they are chased by the blast out of the funnels, and who at the close of the run have seen the deck thickly covered with cinders—although a common one—of waste fuel, but it is to be observed that economy in torpedo boats is a secondary consideration, the primary one being high and long sustained speed. But there are other cases in connection with land as well as with marine boilers where they are forced up to high pressure, so as to get as much steam out of them as possible. In order to produce the necessary heat for this purpose, coals are hustled into the furnace pell-mell and a thick fire is formed which chokes the draught. Then we have the use of fans or blowers in order to force into the furnace the required amount of air for combustion. Out of this practice arises several evils. In the first place, the supply of air is often twice or thrice that which is necessary for proper combustion, and this air absorbs and carries off a large amount of heat. This large accession of cold air, moreover, condenses the gases as they are evolved from the fuel, and these in part create smoke, which, when once formed, cannot be burned. Further the large quantity of air forced into the furnace, precludes the possibility of the gases properly combining, owing to want of time thereby preventing proper combustion. The heat that is developed is, moreover, drawn so rapidly through the boiler tubes that it has not time to penetrate the plates and form steam. Thus from first to last the system of forced draught is beset with evils, the sum total of which is the very opposite of economy. This may be a satisfactory condition of things for those who sell coal, but hardly so for those who have to pay the bills.

The subject of steam boiler efficiency has for some years past formed a matter of careful practical study with Mr. A. C. Engert, and we have from time to time brought his inventions in this direction under the notice of our readers. Last year Mr. Engert designed and had put up at his works a boiler, having two flat flues with vertical tubes and very high steam space, and which possessed great heating surface. The firebars were short, the grate sloping, and there was no ash-pit. Independent tests showed that this boiler evaporated as much as 11.3 and 11.85 pounds of water per pound of coal from 81° F., the steam being very dry. The combustion was most perfect, as shown by the absence of smoke from the chimney noted by us upon several visits which we made to the works. After this Mr. Engert turned his attention more particularly to the furnace, with the view of obtaining the most perfect combustion at the earliest possible moment, and of retaining the flame in contiguity with the boiler plates, so that every atom of heat developed might be utilized in forming steam. In effect, he sought to assimilate the action of his furnace to that of the blowpipe, and to produce a flame similar to that which results from the use of that appliance. This he has succeeded in doing in what he terms his blowpipe-flame furnace, which formed the subject of a paper which was read at a meeting of the Society of Engineers, on Monday evening last. We need, therefore, only here state that in this furnace the ash-pit is dispensed with, and only a shallow curved passage for air left under the firebars. The mouth of the furnace is closed by a hanging door or apron placed within a box entrance and having perforations near its lower edge for the admission of air to the fuel. The furnace is fitted under a double-flued or Lancashire boiler eighteen feet long and seven feet diameter, at Mr. Engert's works, and it has a grate area of seven square feet only, the two flues forming returns for the products of combustion. At the end of the fire grate, which inclines towards the doors, is a firebrick wall three feet six inches thick, and which is carried up to within eight inches of the under side of the boiler at the front and seven inches at the back. Then comes a chamber or pocket three feet long for dust to settle in, and then the bridge proper, which, like the wall or embankment, follows the contour of the boiler and has a space of seven inches between its top and the bottom of the boiler. By keeping a comparatively thin fire, and, above all, by properly disposing and proportioning the air entrances, Mr. Engert is enabled to obtain a transparent flame having a pale greenish tint, as we have, in fact, seen for ourselves. As is well known, this flame gives the greatest intensity of heat, which, however, would be worse than useless if concentrated within a small area, as it would burn the plates of the boiler. In the Engert furnace, however, by means of the brick embankment, the flame is drawn out and distributed over a large surface of the plates, and, penetrating through them to the water, is fully utilized in producing steam. In a word, it is claimed—and the claim is substantiated in practice—that not an atom of oxygen entering the furnace, either from below or from the front, escapes to the flues without having done its work by coming in contact with the fuel and producing almost perfect combustion.

As the worth of a tree is determined by its fruits, so is the value of an invention gauged by its results. In the present instance, we have some remarkably advanced results which, although considerably in excess of ordinary practice, have yet been obtained from actual working, and which thus afford prima facie evidence that Mr. Engert has succeeded in effecting a practical and a practicable departure in steam engineering. The furnace and boiler have been tested by two professional experts independently of each other, namely, Mr. D. K. Clark and Mr. W. Schonheyder. Mr. Clark's test extended over nearly seven hours, during which he consumed 721.5 pounds of coal, and evaporated 150.8 cubic feet of water from a temperature of 70° F. We thus get an evaporation of 13.02 pounds of water per pound of coal from the temperature just stated. The steam is reported to have been dry, and there appears to have been no evidence of priming. The test was made under conditions of slow combustion, only a small proportion of steam being used during the trial for driving the machinery in Mr. Enert's works, as most of the hands were absent on holiday, the day having been Nov. 10 last. Mr. Schonheyder's test was made on Nov. 20, and extended over nearly eight and a half hours. He used 12,857 pounds of water, and consumed 1120 pounds of coal, the mean temperature of the water being 74° F. The evaporation was therefore 11.48 pounds of water per pound of coal from 74°, and 35 pounds boiler pressure. This test was made under the conditions of quick combustion—that is, when the boiler was fully at work supplying steam for driving the whole of the machinery in the factory. Both Mr. Clark and Mr. Schonheyder agree that the combination of the furnace arrangements cause an in-