when the volumes to be pumped are alike, because it is a fact that although water does not boil in an open vessel under 212 degrees, it is quite otherwise in a vacuum or a partial one. Hence, it does appear that in the case of hot water, the moment that the plunger forms the vacuum, just then, the hot water being relieved from pressure, forms into steam more or less and partially fills the pump chamber and thus prevents the regular passage of water through the valve. I therefore conclude that if the water to be injected is of a high and varying temperature its regular flow is not to be depended upon unless the pump be made sufficiently large to contain both water and steam in quantity at the same time, owing to its sudden transition from water, in the supply pipe, to steam, in the vacuum chamber of the pump.

OWEN REDMOND.

Rochester, N. Y.

Volumetric Estimation of Barium.

MESSRS. EDITORS :—All the metals of the third and fourth groups must first be removed by means of suitable reagents, either sulphide of ammonium or sulphureted hydrogen. Acetate of soda is then added in sufficient quantity to displace the acid present, by acetic acid. Heat about thirty-five grammes of bichromate of potassa in an oil bath until all the water of crystallization is thus expelled. As soon as cool weigh out 21.518 grammes of it, and dissolve in one liter of distilled water, then each cubic centimeter of this solution will precipitate .01 gramme of barium, as may be seen by the following proportion :—Ba ; Ko, 2 C O_3 :: 10 : x ; or, 685 : 147.4 :: 10 : x .·. x=21,518 ; .·. since a liter precipitates 10 grammes, one cubic centimeter precipitates .01 gramme. A burette holding 100 cubic centimeters is then filled with the standard solution and placed in a burette stand over the barium solution. The standard solution is then allowed to run into the beaker until no precipitate is formed after the precipitate has subsided, in the supenvatant liquid on the addition of a drop of test solution. This point can be determined more exactly by putting a drop of nitrate of silver upon a glass plate and adding to it a drop of the solution ; if a crimson precipitate is produced it is necessary to add more liquid from the burette ; this is repeated very cautiously until there is no longer any reddish tinge produced in the nitrate of silver. The number of cubic centimeters is then read off, and the amount of barium in the original solution found a simple calculation ; as for example, suppose that 78.9 cubic centimeters have been used, then the amount of barium present would equal 78.9÷1000×10=.789 grammes.

G. H. MANN.

Troy, N. Y.

The Sun's Diameter.

MESSRS. EDITORS:—I find in the SCIENTIFIC AMERICAN, page 179 of the present volume, that the sun's true distance is ascertained to be 92,340,,000 miles. If this be correct, the sun's mean horizontal parallax is 8.85″, and not 8.5776″, as was settled upon by the council at London some years ago. Now, taking 92,340,000 miles as the mean distance of the sun, either the apparent semi-diameter is more than 16′, as is generally given, or the real diameter is less than 886,000 miles, and which is it? A. J. HARRIS.

Wanseon, Ohio.

Ammoniacal Gas as a Motive Power.

The idea of using ammoniacal gas as a motive power in place of steam has been entertained by many inventors, but has never before, we believe, been successfully carried out. A few years ago, MM. Tellier and Flandrin proposed to propel omnibuses through the streets of Paris by its means. They started, or proposed to start, with a vessel of the liquified gas, and supposed that when this was opened, by turning a tap, the gas would be discharged into a cylinder with sufficient force to drive forward a piston ; and water being then admitted to the cylinder, the gas would be condensed, and a vacuum formed, and the piston driven back by atmospheric pressure. Our readers will thus see that the principle of an ammonia engine is pretty much the same as that of Newcomen's steam engine. The plan, if at all feasible, is obviously better suited for stationary than locomotive machinery, and the most reasonable application of ammonia has been made by M. Fromont, who proposes to work a pump by its agency. His engine differs somewhat from that of M. Tellier, inasmuch as he drives the piston in both directions with the gas.

A recent visit to the Paris Exposition has shown us an engine of his actually at work—or, rather, in action, for it was not usefully employed—and driven by a mixture of steam and ammoniacal gas. Strong liquid ammonia is used in the boiler, and the vapor generated is said to be a mixture of at least 80 parts of ammoniacal gas and 20 parts of steam, so it may be fairly called an ammoniacal engine. The principal recommendations of ammonia when applied as a motive power consist in the small amount of fuel required, and the short time it takes to get up the steam, so to speak. The economy in fuel is very considerable, being about one fourth of that required to generate steam alone. As regards the boiler, it may be of either of the ordinary forms, the only complete novelty being the apparatus for condensing the steam and ammonia. The gas disengaged (about six atmospheres at 110° Cent., with an ordinary solution of ammonia) does its work in the cylinder and then escapes into the tubes of a condenser, where the steam is condensed and the gas is cooled. The gas then meets with water from an injector which dissolves it, and the solution is carried on into a vessel called the "dissolver," from which it is pumped back into the boiler to do its work over again. The water for the injector is taken from the boiler, and is cooled before meeting with the ammoniacal gas by passing through a worm surrounded with cold water. These arrangements are necessarily a little complicated, and could not be fully understood without drawings. It is, however, satisfactory to see that an ammonia engine is a possibility, and thus power is obtainable where fuel and water are both scarce.—*Mechanics' Magazine*.

OBER'S PATENT TOILET GLASS.

Not ladies only, but gentlemen frequently feel the want of a convenient mirror by which a view of the back of the head can be obtained when dressing the hair, the common hand glass being inconvenient and requiring one hand to hold it. The device seen in the engraving is convenient and elegant. It is a box designed for holding brushes, combs, and the other paraphernalia of the toilet, having attached a mirror of convenient size and a hinged frame that, when elevated, sustains at its end a smaller glass, which, with the back of the head is reflected in the larger mirror. The jointed frame will permit the adjustment of the small mirror at any angle desired,

and will fold upon itself and on the box, making the whole contrivance, when not in use, portable and convenient. The jointed frame and small mirror may be attached to any ordinary mirror frame. In the form represented in the engraving it is especially adapted to the requirements of travelers, and in any form it is useful in all places.

It was patented through the Scientific American Patent Agency June 25, 1867, by Albert Ober. Further information may be obtained by addressing Ober Brothers, Beverly, Mass.

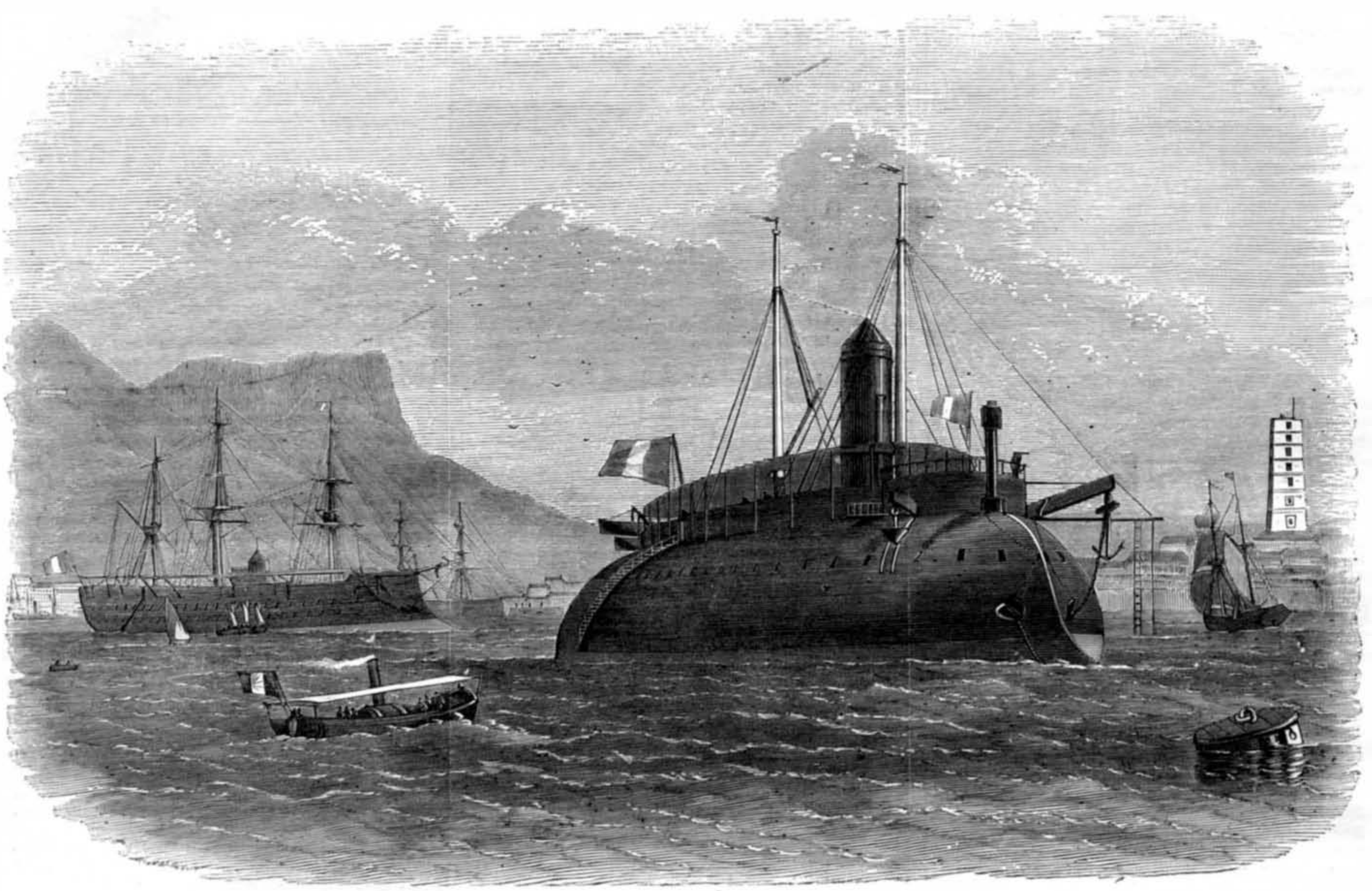
THE ANTIQUITY OF MAN.

The following paper by Mr. J. Crawford, F. R. S. was read in the Ethnological department of the British Association at the late meeting at Dundee :—Man, when he first appeared on earth, was without articulate speech, and, like the lower animals, must have expressed himself by what was little better than mere interjection. He had, therefore, to frame a language—a seemingly difficult achievement, yet one which every savage tribe had been able to achieve, and that not in one place only, but in several thousand separate and independent localities. It followed, then, that as every tongue was regularly constructed and perfect for its own purposes, many ages must have passed before language could have reached its present maturity. Even the languages of a people so low in the scale of humanity as the Australians, incapable of reckoning beyond duality, were found to be not only skillfully, but even completely constructed. It must be evident, then, what ages must have transpired from the first attempts to give names to a few visible objects to the completion even of such rude languages as those of the Australians, Feejeans, and Esquimaux, and how many more must have passed before the discovery of the art of writing. Like languages, the ordinary arts bore abundant proofs of man's antiquity. They were not the results of instinct ; but, on the contrary, bore indications of man's brain and hands. The distaff and the loom were as much inventions as the steam engine and the telegraph. They had been invented in many independent localities, and at so early a time that in no instance had there been any record of the discovery. The discovery of metals, without a knowledge of which man must have ever remained a feeble savage, attested man's antiquity. The difficult art of making malleable iron seemed to have been immemorially known and practised even by the rudest people of the Old World, but it might be fairly conjectured that the first discovery must have been made by natives who had previously made considerable advances in civilization, and that from them the art came to be disseminated among ruder tribes. Were the languages of the negroes of Africa investigated—the rudest of which are known to practise the art of fabricating malleable iron—it would probably be found that it was acquired from the Mauritanians, Carthaginians, and Egyptians on the western, and from the Hindoos on the eastern side of the continent. Cultivated plants and domesticated animals also yielded proofs of the antiquity of man. The countries in which—through the auspicious character of the physical geography and the intellectual quality of the races inhabiting them—the earliest civilization sprang up, were Egypt, Syria, the valleys of the Tigris and Euphrates, India, and China ; and, in a minor degree, Persia, the region lying between India and China, Japan, and one or two islands of the Malayan Archipelago. In all these writing had been early discovered and a calendar formed—arts indispensable to the rudest record of human events. But it was not necessary alone that the capacity for framing a record should exist, it was not less necessary that the monument containing it should be of durable materials, and be under conditions favorable to its preservation. In regions subject to violent alternations of heat and cold, drought and moisture, the most lasting materials were in time decomposed, while in tropical climates the same destruction was produced by a rank vegetation. Hume made true history begin with the first page of Thucydides, but man's story went back far beyond the time of either Thucydides or Herodotus. Egypt was, far beyond all other countries, that in which the chronicle of civilized man could be carried to the highest antiquity. After many dynasties of gods and demigods, the earliest date which, with any show of antiquity, could be ascribed to the history of Egypt began with the first dynasty of civil writers, and the learned made that correspond with the year before Christ 8986, which would make the first dawn of reliable history 10,833 years old, reckoning to our own time. The pyramids of the first dynasty were built, according to the same authority, Lesueur, B.C. 3460 ; the great Pyramid, B.C. 3280—respectively 5327 and 5127 years ago. At the earliest of these dates the Egyptians were already a civilized people, in possession of a high scale of numbers, of a calendar, and of the art of writing ; while at the latest of them they were certainly a numerous people, skilled in architecture, and equal to the construction of gigantic monuments. This history of the Jews could pretend to no such antiquity as that of the Egyptians, or even as that of the Chinese. There was a general assent among critics in fixing the building of the temple to the year before Christ, 1015—a date which would make it 2446 years later than the construction of the oldest of the pyramids. Reckoning backwards, the exodus proceeded the building of the Temple by 480 years, and the bondage in Egypt was given as having lasted 430 years. There were other races of man which, from their conspicuous position, must have made a very early advancement, although probably not equaling that of the Egyptians. The valleys of the Tigris and Euphrates, from the climate, fertility of soil, and facility of investigation, with the genius of their inhabitants, were formed by nature to be the seat of a very early civilization, and we have abundant evidence of such a civilization having sprung up, rivalling that of Egypt in extent and greatly surpassing it in power. Its perishable monuments, however, do not furnish us with the same satisfactory evidence of antiquity as do the enduring monuments of Egypt. After a reference to the civilization of Assyria and India, the paper concluded as follows :—I may conclude this paper with a recapitulation of the conclusions which may, I think, be legitimately deduced from the facts stated in it. Man, although the latest creation of the class of beings to which he is most nearly allied, is yet of vast antiquity, although that portion of his history which has transpired since he acquired the art of making a durable and authentic record of his own existence, forms but a very small fraction of it. From the time in which he acquired the skill to frame this record, we have to trace him back over the many stages he had to pass through up to the discovery of his remains in caves, and those of his handiwork in the most recent geological formation, "the drift." We must, indeed, go beyond this, and up to his first appearance, when he was without speech, ignorant of every art, and, like the lower animals, chiefly guided by instinct. This is to be inferred from the fact that, where material evidence of man's presence exists, where in caves or "drifts," he is already found in possession of implements of stone, implying a considerable step in advance. But the localities in which the physical geography of the land and the genius of its people combined to effect such an early social advancement as was necessary to be attainment of the skill indispensable to the production of a reliable and enduring record of human events, however rude and imperfect, have been few in numbers, and confined to such as I have endeavored briefly to enumerate. Over the greater part of the earth's surface, auspicious locality and genius of race were not so combined as to have enabled mankind to reach that point. The red man of America, the shepherds of Tartary, the black races of Africa never even approached it. The most highly endowed and the most happily situated of the nations of Europe had reached it only in comparatively modern times, and might not, indeed, have reached it at all had they not borrowed largely from their more precocious neighbors of Asia. The physical geography of the wild region of Tartary, independent of the quality of race, has ever made it impossible that man should have advanced beyond the condition of migrating shepherds, who have now and then united in formidable hosts, and proved the scourges of civilized man. The peculiar privations, both as to locality and race, which characterize some regions of the earth have made all advance in arts beyond what was indispensable to a bare preservation of existence impossible, and of this we have examples in the land of the Esquimaux and of the Australians. In a few localities even this amount of skill had not been attained. Thus Spitzbergen, Nova Zembla, and even Iceland, when first seen by civilized man, were uninhabited ; and when we see the Esquimaux living and multiplying and spreading in equally rigorous or even more rigorous climates, it is hard to believe but that they must once have had an aboriginal population, seeing that at least animal food is abundant in them. If they had they must have perished for want of skill to maintain existence. New Zealand would seem to have had no native inhabitants until it came to be colonized by savages and cannibals from the tropical islands of the Pacific. It is difficult in this case, too, to believe that prolific nature should have left so large a country without aboriginal inhabitants, yet it is more probable that the aborigines were either extirpated or absorbed by the more powerful invaders, than that they perished from want of skill in the arts.

The First French Iron-clad.

Our engraving represents the appearance of the great ram constructed by order of the French Emperor, and which made such a nervous stir among the officials of the English navy some two years ago. At that time the performance of our initial *Monitor* and the accompanying efficiency of our other iron-clads had awakened a remarkable interest in the construction of war vessels among other nations. Impregnability and efficiency in assault were the two almost opposing qualities which it was desirable to combine in naval vessels. This was attempted in the *Taureau*, which is an iron-plated ram, defended by its plating and having its only means of offense in a single gun mounted near the bow in a turret. The principal advantage expected from the ship was its immense beak or prow, the ship itself being used as a projectile, to be hurled against those of an enemy. The sides of the vessel are protected by armor extending only about three feet above the water line amidships, and abaft and at the bow by five inches thickness of armor. The engines, two in number, are each of 250-horse power, and the vessel 197 feet long by 48 wide.

As a menace to hostile powers the *Taureau* may be valuable, but as a means of offence or defense it is doubtful if it would equal one of our unpretending monitors.



THE FRENCH IRON-CLAD RAM "TAUREAU."

How Guns are Fired.

The earliest means adopted for igniting the charges of big guns would seem to have been red-hot spikes or bars, which were introduced into the vent, and a pair of bellows for heating the irons formed a necessary part of the artillery equipment of the fourteenth and fifteenth centuries. The inconvenience and danger attending this plan became more conspicuous as the size and power of guns increased, and by the middle of the fifteenth century it had been almost entirely superseded by the system of priming with loose powder, a small train of which was laid up to and through the vent. But the red-hot priming irons were not at once got rid of, for until the adoption of a match made for the purpose, they were still used to ignite the priming powder; and of this match, or of the linstock used for holding it, we find no mention until some time in the sixteenth century. About the beginning of the seventeenth century the priming powder was in part superseded by a small piece of quickmatch, which, being introduced into the vent, acted like a weak tube. To this match the name *portefeu* was applied—a name which we still retain, although the modern "portfire," it need hardly be said, is a very different thing from the ancient *portefeu*. It is remarkable that, although the flint had been introduced about this time, or even earlier, as a means of firing small arms, no attempt seems to have been made for about 200 years to extend its employment to cannon. But the subject did not stand still, and a great improvement was effected in the first half of the eighteenth century, when the quickmatch or *portefeu* was no longer used by itself, but was placed inside a small tube, which could be dropped into the vent, the head of the tube being primed, and the train of loose powder which led up to the vent being done away with. It was not until the beginning of the present century that the simplification of reducing all tubes to one uniform length was effected, but by this time the peculiar action of a tube came to be understood. This action is due to the hole in the center of the composition, the effect of which is to expose a large surface of composition to immediate ignition, and the gas which is thus generated, being subjected to considerable pressure in the cavity, necessarily rushes in the only direction in which an escape is open to it—viz: through the tube—with accumulating force, causing an explosion, the effects of which are directed in the prolongation of the tube. The adoption of a safer and more rapid means of ignition is due to Sir Charles Douglas, father of Sir Howard Douglas, the well known writer on naval gunnery.

In 1778 he formally submitted various propositions "forimproving, facilitating, and quickening the service of naval ordnance," including the introduction of flint locks and quill tubes. His propositions were not immediately entertained, and their employment on land never became very general, and tubes ignited by a match or portfire were generally used until 1845 for land-service guns. The next great improvement was the application of the percussion principle of ignition, an improvement of considerable importance at sea, since it made the firing of the gun more instantaneous, and and thus considerably increased the accuracy of the practice made from the ever-moving platform of shipboard. No tubes of this sort were made for actual service until about 1831. They were contrived by Mr. Marsh, of the Royal Arsenal Surgery, and improved upon in 1846 by Col. Dansey, R. A. They consisted of a quill tube, with a small cross-quill filled with a detonating composition, which was exploded by the blow of a hammer fixed to the gun. For land-service, percussion tubes do not seem to have been used until about the year 1845, when they may be considerdd to have been established for both services, although their application to land guns was only partial. Meanwhile attention had been directed to a tube which was brought to this country by a German officer, which depended not upon percussion but upon friction for its ignition. In 1851 Mr. Tozer, of the Royal Laboratory, succeeded in perfecting a copper friction tube of the pattern now in use, which was adopted for all land-service artillery in 1853. It was not recommended for naval service on the ground that any metal tube would be dangerous and highly objectionable between decks. But by 1856 a quill friction tube had been designed and adopted for naval service—the percussion tube being retained, however, in a certain proportion, until last year, when it was formally pronounced obsolete. The introduction of friction tubes was a great improvement for both land and sea service; in the field they superseded the common tubes and portfires, which had rendered the service of the guns slow and imperfect, and the use of which was attended with the risk of setting fire to ripe corn, dry grass, etc., from the ignited ends of portfire which were cut off and thrown down. For sea, garrison, and siege services they got rid of the hammer, making the firing of the gun even more instantaneous and convenient. These are the tubes now generally in use. There remains only to be noticed a system of firing guns by electric agency, which is largely used at proof and for experimental purposes, when it is desirable for the firing party to be under cover. The first employment of electricity for firing gunpowder dates as far back as 1751, and is due to Franklin; and in 1767 Priestley turned his attention successfully in the same direction. Our space will not permit us to detail the various contrivances which have been proposed. Suffice it to say that it was not until 1856 that Mr. McKinlay, the proof-master at Woolwich, submitted his galvanic tube, the principle of which consisted in causing the current of electricity to pass at one part of its circuit through a wire of inferior conducting power, which, becoming instantaneously heated to redness, ignited the priming in the head of the tube in which it was embedded. The last improvement in this direction has been the application of magneto-electricity, which was successfully accomplished in 1862, by Messrs. Abel and Wheatstone. The inductive apparatus used with these tubes is extremely simple, portable, and durable. The electric tubes are used also for firing "time guns" at Edinburgh, Glasgow, Sunderland, and other northern towns, the current being daily flashed at noon along ordinary telegraph wires from the Royal Observatory at Greenwich.—*Pall Mall Gazette.*

Editorial Summary.

SEWING-MACHINE FACTS.—The following interesting statistics we gather from the quarterly returns, made, we believe, under oath, by the several manufacturers of sewing-machines throughout the United States. The figures which we present, and which we have been at some pains to collect, show at a glance the wonderful growth and great importance of this branch of American manufactures. It will be observed that one company alone has produced and sold within the year over *forty-three thousand sewing machines.* It is somewhat remarkable that, during the recent stagnation in trade, this business has been but slightly, if at all, affected. But below are the figures in detail:—

Sewing-machines manufactured and sold, as per quarterly returns, for the year ending June 10, 1867.

Double-Thread Machines:	
The Singer Manufacturing Co	43,053
The Wheeler & Wilson Mf. Co.	38,055
The Grover & Baker S. M. Co	32,999
The Howe Machine Co.	11,053
The Florence S. M. Co	10,534
The Weed S. M. Co	3,638
The Elliptic S. M. Co	3,185
The Ætna S. M. Co	2,958
The Finkle & Lyon S. M. Co	2,488
The Empire S. M. Co	2,121
The Leavitt S. M. Co	1,051
Total double-thread machines	151,135
Single-Thread Machines:	
The Wilcox & Gibbs S. M. Co	14,152
The Shaw & Clark S. M. Co	2,692
The Goodspeed & Wyman S. M. Co	2,126
Total single-thread machines	18,970

The foregoing facts and figures we find in the *Financial*