Scientific American.

ESTABLISHED 1845

MUNN & CO., - - - EDITORS AND PROPRIETORS.

PUBLISHED WEEKLY AT

No. 361 BROADWAY, - - NEW YORK.

TERMS TO SUBSCRIBERS

One copy, one year, for the United States, Canada, or Mexico $3.00
One copy, one year, to any foreign country, postage prepaid. £0 16s. 5d. 4.00

THE SCIENTIFIC AMERICAN PUBLICATIONS.

Scientific American (Established 1845).....$3.00 a year
Scientific American Supplement (Established 1876) ..... 5.00 "
Scientific American Building Edition (Established 1885). ..... 2.50 "
Scientific American Export Edition (Established 1878) . ..... 3.00 "

The combined subscription rates and rates to foreign countries will be furnished upon application.

Remit by postal or express money order, or by bank draft or check.

MUNN & CO., 361 Broadway, corner Franklin Street, New York.

NEW YORK, SATURDAY, OCTOBER 5, 1901.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

THE TOWING TANK AND THE DEEP SEA.

Yachting enthusiasts who compared the behavior of "Shamrock II." and "Columbia," in the lumpy sea and light wind that prevailed in the first inconclusive contest of the season for the "America" Cup, must have been impressed with the great difference in the movements of the two yachts. The strong wind of the preceding day had died down and left a short, broken sea rolling in from the ocean. Beating to the outer mark, the yachts were taking this sea alternately on the starboard and port bow. They had no sooner crossed the line than it was evident that the relatively sharp bow with its V-sections of "Columbia" was better suited to meeting and lifting the yacht over the seas than was the more round and flaring bow of "Shamrock II." As "Columbia" pushed her nose into a sea she would rise with a gentle rhythmical motion, and as the crest passed amidships she would drop with the same easy swing into the trough of the next wave. The rise and fall of the vessel gave her mast something of the even beat of a pendulum. "Shamrock II.," as we have often remarked in these columns, is unusually full in her forward sections and unusually lean in her afterbody, the center of displacement, with regard to the length of the vessel, being considerably further forward than in "Columbia." Hence, when she met the seas her great displacement forward caused her to rise with a sharp jump, which was accentuated by the rapid drop into the trough of the sea as the wave passed to her shallow afterbody. She came down with a crash that must have tried every spar and rope throughout the vessel, and the effect was instantly noticeable, especially as the wind grew lighter, in a distinct checking of her way. As long as the breeze held true the result was not disastrous, and, indeed, for the first three hours of the beat to the outer mark she held her own fairly well with the "Columbia." During the last hour of the beat the breeze lightened rapidly and the "Columbia" drew away with remarkable ease, the pounding of "Shamrock II." serving to bring her at times almost to a standstill.

The peculiar lines of "Shamrock II." were determined by towing-tank experiments; and we have no doubt that for sailing in smooth waters, such as she has preferred in her tuning-up trials inside Sandy Hook, she is an admirably modeled craft. Yachting contests, however, are not carried on in towing tanks; and while we have not the slightest doubt that Mr. Watson had fully in mind the great difference between towing a model in smooth water and driving the full-sized yacht in a troubled sea, we cannot but think that the abortive contest on Thursday showed that theory has been pushed a little too far. We have already stated in this journal that "Shamrock II.'s" form would indicate that she would have difficulty in holding her own with "Columbia" when close-hauled in a short, broken sea, and the first attempt to sail a race has abundantly confirmed this impression.

The weather conditions were an exact repetition of those which rendered the contests of 1899 so enormously wearisome and disappointing—a fair sailing breeze at the start, which steadily fell away as the race proceeded, and dropped entirely when the leading boat was yet several miles from the finish. While the Sandy Hook course is, in the absence of shoals and currents, one of the finest and fairest in the world, we consider that for September and August racing the weather conditions are about the worst that could be conceived. Should the Cup remain on this side, as it seems more than likely to, we think that future contests should be arranged to be sailed in the earlier part of the summer, when better weather conditions are likely to prevail.

The first completed race of the series proves that there is little to choose between the two yachts under the prevailing weather conditions. In place of the short sea of Thursday there was a long ground swell, and the wind held true, with a force of from 7 to 9 knots an hour. At the start "Shamrock II." was slightly to weather of the "Columbia," but only two seconds ahead over the line. This advantage she held to the outer mark. She pointed equally high with the "Columbia," and for two hours and a half there was witnessed a magnificent contest between the two boats for the weather position, "Columbia" making three unsuccessful attempts to cross the "Shamrock's" bow. It was noticeable that "Shamrock" showed to best advantage when the wind strengthened—a fact which suggests that in breezes of over 10 knots she will prove the faster boat. To the outer mark "Shamrock II." made six tacks and "Columbia" twelve. After two hours' sailing they were so close together that the shadow of "Shamrock's" topsail was thrown on the mainsail of "Columbia." On the last board to the outer mark, "Shamrock II.," because of her windward advantage, was sailed with a freer sheet, and gained 41 seconds in two miles. Running home in a falling wind, "Columbia" pulled up and passed the "Shamrock II.," crossing the line about two lengths or 37 seconds in the lead, and 1 minute and 20 seconds, corrected time.

THE ROYAL TOMBS AT ABYDOS.

Recent Babylonian discoveries have challenged the primacy of Egyptian civilization. There is not, however, the same continuity of record in Mesopotamia as there is in Egypt. There was a time when scholars were apt to look askance at everything which antedated the Greek historians, and the first three dynasties were considered as a tissue of fables. The last two years have seen wonderful discoveries in Egypt, for the tombs of the kings at Abydos have been opened, and the treasures which have been found place us face to face with the beginnings of history. Dr. W. M. Flinders-Petrie describes the recent discoveries in the current issue of Harper's Monthly Magazine. He says that the oldest record of human history is the statement that ten kings reigned at Abydos in Upper Egypt during a period of 350 years before Mena, who has usually been considered as the founder of the first dynasty. In reality these earlier kings were the real founders of the Egyptian state, and we now know not only their names, but are able to obtain some idea of their mode of life and the culture which they attained. The date which Dr. Flinders-Petrie assigns to the pre-dynastic kings is from 4900 to 4800 B. C., and the names of the four whose tombs have been examined are given as Ka, Zeser, Narmer and Sam. Among the remarkable finds were a carved slate slab showing King Narmer smiting his enemy, an ebony tablet, a bar of gold, gold jewelry, including bracelets, and a royal scepter. The oldest group of jewelry in the world is undoubtedly the four bracelets of the Queen of King Zer (4715 B. C.), which was discovered with a portion of the mummy in a hole in a wall. This is 2,000 years earlier than any other jewelry thus far identified. The bracelets show a wonderful perfection in the soldering of the gold. In no case can the joint be detected with a magnifying glass, either by color or a burr edge. The proof that solder was used is in the inside of the ball buttons, where a wire shank is joined in and not hammered in one piece; the wire is hammered and not drawn.

It is surprising that this valuable jewelry should have been found, as the king's tomb was repeatedly plundered. It is probable that one of the looters thrust this fragment of the mummy into the hole in the wall, intending to return at some subsequent period and remove it. The bracelets show the turning point in the development of Egyptian art, the finest bracelets being formed of alternate plaques of gold and turquoise, each surmounted with a royal hawk. The turquoise plaques have a more archaic and lumpy form of hawk than do the gold pieces, and show that during a comparatively short period, little more than half a century, rapid crystallization in art took place, and at the end of his reign the forms are practically identical with what continued for more than 4,000 years later. Dr. Flinders-Petrie considers that this is comparable to the sudden fixation of the final forms which is seen in Greek art, where an interval of only forty years, between the time of the Persian war and the Parthenon, sufficed for the evolution from archaic work to the greatest perfection.

Each of the royal tombs had two large tombstones, bearing the name of the king, and private tombs of all the court and domestics were placed around that of their royal master. They are nearly all built of brick, in most cases with a timber lining to the chamber, sunk in the ground. They were originally roofed over with beams, matting and sand. They lie about a mile back from the Temple of Abydos and they were excavated by the Egyptian Exploration Fund. It is possible that many of the objects found will pass into American possession. Dr. Flinders-Petrie justly states that we now know far more about the civilization of these oldest-known kings than we do about the Saxon kings of England, and the reality of the very earliest part of the history of the world is now placed beyond question by these discoveries.

THE TRUE POINT OF VIEW.

One cannot but be struck, sometimes, with the fact that of late the English, or a large section of them, have shown an almost brutal frankness in criticising their own industrial methods and comparing them with those of this country to the disadvantage of the former. According to the popular idea, this betokens a want of patriotism; whereas, as a matter of fact, it is patriotism of the highest order. If there is one branch of its engineering work which the citizens of that great manufacturing country have been proud of, it is its railroads, and particularly the motive power. Although, judged by itself, the English engine is a beautifully finished and highly economical machine, it is not so strictly economical when considered as a part of the whole administration and operation of a railroad system as such. Col. Constable, the manager of one of the great railway lines of India, recently visited the United States to study her railway system. He is one of those British officials who are getting to look at the question of locomotive economy from the broader standpoint. In his report recently submitted to the Indian government and, through it, laid before the British Board of Trade, he states that while there is no doubt that the American engine burns more fuel and goes to the repair shop sooner than the English locomotive, the American builders do not construct their engines with the expectation of their lasting more than fifteen years, since they consider that at the end of that time the development in the size and power of engines, and in the loads to be hauled, will be so great that the fifteen-year-old locomotive will be somewhat out of date, unequal to the increased demands of traffic and therefore ready for the scrap heap. Col. Constable states that the great hauling capacity of our engines makes up for any defects in their details. He is further of the opinion that locomotives of light weight and small power are kept too long in service on the Indian railroads. The report hits the nail upon the head when it says that the first duty of the engine is either to run fast or to pull a big load. Its author says that he would rather have a roughly finished engine that would haul 3,500 tons than a highly finished, spick-and-span beauty that could only haul 600 or 700 tons in England or 1,200 tons in India. He considers that since the cost of coal is only one feature in the cost of carrying a ton of freight, the East Indian railway would be benefited by using cheap coal, and using engines that could haul loads of American dimensions, even should its coal consumption per engine-mile be doubled, and its engines have to be sent to the scrap heap at the end of fifteen years. The report concludes by saying that, as a matter of practice, the American lines prefer to run an engine for all it is worth, provided traffic is offering, merely allowing sufficient time for cleaning and repairing.

It is certain that American methods, as thus outlined by this British official, are destined to become prevalent in the colonies of Great Britain wherever the loading gage permits the use of more powerful locomotives. In Great Britain there is a limit set to the size of the engines by the low bridges and the comparatively narrow width between station platforms; but even under these restrictions, it is possible for British locomotive builders to greatly increase the size and power of their boilers above the limits which generally obtain to-day.

THE HOLLAND SUBMARINES FOR THE BRITISH NAVY.

The first of the five submarine vessels of the Holland type, now being constructed by Messrs. Vickers' Sons & Maxim for the British navy, will be placed in commission in the course of a few weeks. Each boat will measure 63 feet 4 inches over all, with a beam of 11 feet 9 inches, while the displacement will be 120 tons. The crew will comprise seven officers and men. The motive power consists of a 4-cylinder vertical gasoline engine for surface propulsion. The motor will have a speed varying from 200 to 300 revolutions per minute, and its maximum brake horse power will be 190. The storage capacity will enable the boat to travel 400 knots at 9 knots per hour on the surface. On the surface the boat will have a maximum speed of approximately 10 knots, while the speed when submerged will be about 3 knots less. For propelling the vessel when submerged a main motor of electric waterproof type is provided, the current being supplied from accumulators sufficient in capacity to enable the vessel to remain under water for a four hours' run at maximum speed. The accumulators are charged from a dynamo driven by the gasoline motor while traveling on the surface. At the bow of the boat is the torpedo-launching tube placed about 2 feet below the load line, while the vessel is on the surface, and in addition to the torpedo, which will always lie

in position in this tube, four others will be carried. The boat is provided with a hull of sufficient strength to permit the submarine to descend to a depth of 100 feet, and the water tanks are of small dimensions, so that the size of the moving masses of water is considerably reduced, while at the same time there is every facility for filling and discharging them to readjust the balance necessary for stability when the vessel is diving or returning to the surface. The boat is fitted with four rudders, two of which are for steering on the surface, and the other two to be employed for diving. The official trial is to consist of a surface run of 10 knots, which is to be covered within the hour, while the submerged run will be 2 knots, to be accomplished at an hourly speed of 7 knots. When the runs have been undertaken a surface torpedo will be discharged at a target 150 feet in length by 16 feet deep, the upper edge of the target being awash and placed at right angles to the course of the submarine. While the boat is undertaking her submerged trials she will not rise to the surface on more than three occasions from the time of starting until the firing of the torpedo, the duration of each appearance not to exceed one minute.

BELLEVILLE VERSUS CYLINDRICAL BOILERS.

PRESIDENT OF BRITISH ADMIRALTY COMMITTEE'S REPORT.

Vice-Admiral Compton-Domville, the president of the committee appointed by the English Admiralty to investigate the efficiency and reliability of the Belleville boilers in comparison with the cylindrical boilers, has issued his report concerning the trial run that was undertaken from Portsmouth to Gibraltar and back by the two sister ships "Hyacinth" and "Minerva" at full speed. The former vessel is fitted with the Belleville boilers, while those of the latter are of the Scotch cylindrical type.

Representatives of the boiler committee embarked on board these two vessels at Devonport on July 6 last. Both vessels started from that port for Gibraltar at 3 o'clock in the afternoon of the same day and commenced working up to 7,000 horse power. It was intended that the ships should maintain 7,000 horse power till all the coal, except the 82 tons in the reserve bunkers, was exhausted. Three-quarters of an hour from the start the revolutions of the "Hyacinth" were 152 per minute and the horse power 6,994, and her trial started from this time. The "Minerva's" trial commenced a quarter of an hour later. The latter vessel soon showed that she was the faster ship, and steadily drew away from the "Hyacinth." By midnight on the 7th she was about four and a half miles ahead.

It had been arranged that the water in the reserve tanks of both ships should be used as the only make-up feed-water until it was reduced to 20 tons, in order that the amount of make-up feed used per day might be accurately determined. When the reserve had been reduced to 20 tons, this water was to be kept intact in the tanks ready for use in case of emergency, and all make-up required was to be obtained from the evaporators. Special reserve tanks had been fitted on the "Hyacinth" to hold about 100 tons; this, added to the original tank stowage, gave a total reserve tank stowage of about 140 tons. The total reserve tank stowage on the "Minerva" was about 170 tons.

When the amount was reduced to 35 tons on the "Hyacinth," the staff engineer asked to be allowed to start the evaporators, on account of the difficulty of getting the water out of the tanks by the special pump fitted for these trials. Two Weir's evaporators working with exhaust steam were started for the purpose.

At 1:15 A. M. on July 11, the staff engineer of the "Hyacinth" reported the engines would have to be eased on account of the large loss of water, and the trial was abandoned from 1 A. M. All the evaporators were working at this time, and in addition to the water from the reserve tanks, 25 tons of drinking water had been used for boiler make-up. The "Hyacinth" steamed into Gibraltar at slow speed, arriving there on the 11th, in the evening.

The "Minerva" continued steaming at 7,000 horse power till 11 P. M. on the 12th, at which time there were still 39 tons of coal in the bunkers, not including the reserve, and 20 tons of water remained in the reserve tanks.

The average horse power of the "Hyacinth" was 7,047 for 103¾ hours, with a coal consumption of 1.97 pounds, and the distance run was about 1,810 miles at an average speed of 17.6 knots. The "Minerva's" horse power was 7,007 for 147 hours, with a coal consumption of 2.06 pounds, and the distance run was about 2,640 miles at an average speed of 17.96 knots.

On the night of the 10th flaming occurred at the after funnel of the "Hyacinth," but no such flaming occurred on the "Minerva." When the boilers of the latter vessel were examined upon arrival at Gibraltar the openings in the Admiralty ferrules were seriously choked, the sizes of the openings in some cases being reduced to about one-third of the original.

The boilers and engines on both vessels worked well on the way out, with the exception of the breaking of the eccentric-strap bolt of the starboard intermediate engine of the "Minerva," which delayed her for about two hours. A number of leaks developed in the "Hyacinth's" boilers, which became worse when the vessel was eased up when entering a fog, on which occasion the steam pressure became sufficiently high to lift the safety valves. The loss of water was at first attributed to leaky feed-suction pipes, but during the stay at Gibraltar these pipes, the feed, and the hot well tanks, and the boilers and boiler blow-outs, were water-pressure tested, and no leaks, beyond those already known to exist in the boilers, were discovered. The leaky joints were remade by the ship's staff while at Gibraltar, and on the 16th the ship was taken out for a run at about 7,000 horse power, to test the amount of feed-water being lost. This was found to be at the rate of 55 tons a day, according to the record of the six hours' run. The boilers of both ships were thoroughly cleaned out at Gibraltar, so that the race home might be determined under the most advantageous conditions.

Both ships lay at anchor—the "Hyacinth" with two boilers alight for auxiliary purposes, and the "Minerva" with one alight. The homeward run was commenced at 4:27, by a previously unknown signal, on the 20th. Directly the signal was given the fires were lighted in the boilers not at work and the ships were headed for Portsmouth. Both ships started punctually at 4:30—three minutes after the signal. The "Hyacinth's" engines were worked slowly in accordance with orders from the deck, steam being supplied by the two boilers which were alight. At 4:52 the after group of boilers was connected up; at 5:05 the forward group; and at 5:09 the middle group were connected up, the steam pressure being 22 pounds. At 5:20—less than one hour from weighing anchor—the "Hyacinth" was proceeding at 150 revolutions per minute, the horse power being nearly 7,000.

When the "Minerva" set sail the boilers were also worked slowly. The second boiler was connected up at 4:55; the third at 5:02; the fourth at 5:07; the fifth and sixth at 5:10; seventh at 5:12; the eighth at 5:15. The engines were working up to full power at 5:16, but had to be eased several times during the next three hours, owing to the eccentric straps warming up.

At 5:15 on the 18th the "Hyacinth" was about six miles ahead of the "Minerva." Both ships, however, ran into a fog, and the "Minerva" caught up to the "Hyacinth," and at 9:30 A. M., on emerging from the fog, the "Minerva" was still ahead. Both ships then worked up to the maximum, but throughout the day the "Minerva" gained one-third of a knot per hour on the "Hyacinth." At 7 P. M. another fog was encountered, and the ships went slow through the night, keeping close to each other.

At 9 A. M. on the 19th they were again level, but during the day the "Minerva" again gradually drew ahead, traveling a quarter of a knot per hour faster. At 7 P. M. the "Hyacinth" again eased, owing to a fog, and went slow till 5 A. M., the "Minerva" being out of sight ahead. The "Hyacinth" then steamed at over 9,000 horse power till 6:10 on the 20th, when the fires of 10 boilers were drawn on account of a burst steam tube. At 9:50 P. M. the trial finished, the ship then being off St. Catherine's, and she arrived at Spithead at 11:30 P. M. The "Minerva" had anchored at Spithead 1 h. 45 m. previously. The coal consumed in the "Hyacinth" on the way home was 550 tons; on the "Minerva" it was 451 tons. The "Hyacinth" used her evaporators all the way; the "Minerva" utilized hers but very little.

The maximum power developed by the "Minerva" was 8,700 horse power, while that developed on the "Hyacinth" was nearly 10,000 for at least two hours, during which time the "Hyacinth" did not perceptibly gain upon the "Minerva." The "Hyacinth's" average power while running clear of fog was about 9,400 horse power, and the "Minerva's" about 8,400 horse power. From the results of the outward run it appears that the radius of action of each of these vessels at 7,000 horse power, as far as the coal is concerned, should roughly be: "Hyacinth," 2,930 miles; "Minerva," 3,000 miles. No difficulty was experienced in either ship during any part of either the outward or homeward runs to maintain a sufficient supply of coal to the fires.

Following the report of the president of the committee is one by Rear-Admiral W. H. Hay, Controller of the Navy, relating to the condition of the boilers after their unusual exertions. He draws the attention of the Admiralty to the following points in this trial:

(1) The very serious loss of water in the "Hyacinth," as pointed out by the president of the committee. This was due to leaky joints. A certain number were located at Gibraltar, and on examination at Portsmouth other leaks were discovered and reported.

(2) The state of the "Minerva's" tubes at the end of each run. On arrival at Gibraltar the cup ferrules were discovered to be partially choked, due to bird-nesting, and the ship could not have gone any further at that power (7,000). As it was, she was using up to 1.7 inches of air pressure, instead of ½ inch, to maintain the necessary combustion for this power. On arrival at Portsmouth practically the same thing occurred.

(3) The "Hyacinth" developed an average of 1,000 more indicated horse power than the "Minerva" on the run home. This should have given the former a substantial increase in speed, whereas there was a slight decrease. This extra indicated horse power must have been absorbed either in the engines, or on the main shaft's bearings, or in the hull. It is possible that the shape of the hull may have had something to do in the matter, but former trials do not bear this out. For example, when the "Highflyer" (same class) was tried against the "Minerva" last year, the former maintained a higher power and speed, except at 10 knots, when she had to exert more indicated horse power to obtain the speed.

The Controller of the Navy, in his conclusion, significantly remarks that this last feature of the Belleville boilers requires investigation. Although these trials were not conducted under the most satisfactory conditions, yet they conclusively established the relative merits and disadvantages of the two types of boilers, and the cylindrical boiler appears to have issued from the ordeal with the greatest success. It has been proved to be far more economical, in every respect, than the water-tube boiler.

SCIENCE NOTES.

The contest for the Pollok prize is now open, and it is to be hoped that this competition will result in the award of the prize to some American inventor.

An exhibition for accident, sanitary, and life-saving service is to be held at Frankfort October 5 to 21. It is to be exclusively scientific. Visits of workingmen will be arranged, as the chief aim will be to benefit those engaged in industrial pursuits.

Consul Haynes, of Rouen, under date of August 26, 1901, says that the metric system is to-day compulsory in twenty countries, representing more than 300,000,000 inhabitants—Germany, Austria-Hungary, Belgium, Spain, France, Greece, Italy, Netherlands, Portugal, Roumania, Servia, Norway, Sweden, Switzerland, Argentine Republic, Brazil, Chile, Mexico, Peru, and Venezuela—and advises American exporters in dealing with any of these countries to adopt the system.

The Italian government has definitely decided to restore Leonardo da Vinci's "Last Supper." Ordinarily the restoration of a masterpiece of painting would be regarded as dangerous in the extreme, but in this instance the conditions are peculiar. The picture is in such a bad condition that it would be difficult to spoil it, and the work will be done in the most careful and scientific manner. A celebrated expert has been engaged to give his services, and the first work will be to destroy the micro-organisms which are eating up the paint. The wall will then be treated so that it will not be damp in the future, and then the work will be "restored" with the help of the old copies of the fresco and the engravings of it.

The dangers attending laymen who undertake to act as judge, jury, and advocate in legal matters are well shown in a recent trial for infringement in England. A party had invented a pneumatic hammer and established a business in it, when other parties also embarked in the manufacture, having patented the same device. These last were sued, when they set up a defense of prior publication before the first, or original, patent was issued. The judge required the alleged infringers to prove the prior publication—they having admitted the infringement. It then appeared that the ostensible prior publication was not a fact; there had been no publication whatever in the legal meaning of the word, but merely a conversation between two tradesmen as to the commercial value of the hammer. Upon such a slender base as this the defendants had gone to considerable outlay with the belief that their view of the situation was correct. In cases of this kind it is much better to take professional advice than to act upon intuitions or beliefs.

THE "FOOL KILLER" TAKING SOUNDINGS.

In our last issue we described Peter Nissen's "Fool Killer," which is intended to be used in taking soundings in the Niagara River, and, if possible, pass through the Whirlpool Rapids. Nissen began making soundings on September 21. He maneuvered the "Fool Killer" in a satisfactory manner, showing that it was a very stanch craft. The boat was run repeatedly into the spray so that it was hidden for several seconds. Then it would emerge, and under a full head of steam would toss among the waves with the water dashing over it and threatening to capsize it. He found the rocky bottom of the river very uneven, its depth varying from 15 to 100 feet.