that chemically pure aluminium is capable of resisting even sea water, a fact which is of great importance in marine engineering.

The credit for having first welded aluminium must be conceded to the Heraeus Company of Hanau, Germany, which, as early as 1900, exhibited at the International Exposition at Paris a number of aluminium articles, which had been welded by means of a special process (German patent 118,868). This process is based upon the fact that at a certain degree of heat aluminium becomes soft, and can be combined with a similarly-heated aluminium body by means of hammering. In principle this method corresponds exactly to the well-known welding process used for iron in the ordinary smithy. This method, however, has a disadvantage which tends to prevent its introduction into practice, which is that it is extremely difficult to maintain the exact temperature necessary for the welding, and it is possible only if the workman is extremely skillful. If the temperature is too high the metal, when hammered, will spurt in all directions, while if the heat is insufficient, no combination of the surfaces in question takes place. Accordingly, it is apparent that this process leaves much to be desired in practice, and is absolutely unsuited to the working of thin material or complicated objects.

In the autogenous blowpipe welding of aluminium according to the Schoop process, no question of this character can arise. Upon purely theoretical grounds it appears that the formation of local galvanic circuits is impossible if foreign metals are not present. Furthermore, the thickness of the metal is quite immaterial, and it is possible to weld sheet aluminium 1 inch or 0.008 inch in thickness with the same ease.

On the recommendation of the Neuhausen Aluminium Factory, of Switzerland, a series of tests were made, the purpose of which was to show whether or not the welding point underwent disadvantageous changes if immersed in water for a longer time. As was to be foreseen from the theoretical considerations underlying the process, the results were in every particular negative. That is, even after months in contact with water the soldered or welded points were found to be in exactly the same condition as the other parts of the material. In one particular case a soldered aluminium article remained for three months in salt water, without the appearance of the slightest chemical or physical change at the soldered points. Similarly favorable were the results of the official rupture and tension tests executed by the testing laboratory of the Conservatoire National des Arts et Métiers at Paris in May, 1905. Of greatest interest by far are the results of a photo-micrographic investigation carried out by the same institute. As is well known, a test of this character is extremely sensitive, and the slightest changes of a metal in regard to its structure, color, and constitution are at once perceptible with mathematical certainty. The result of this test showed that the welding points possessed exactly the same characteristics in regard to their chemical and physical properties as did the pure aluminium, and, furthermore, not even the slightest trace of impurities (resulting from the flux) could be determined.

The soldering or welding process itself is as follows: The parts to be joined are either bluntly placed against each other or one above the other, after all adhering dirt has been removed from the surfaces. However, aluminium which has a bright appearance needs no preliminary cleansing, in contrast to that usual in the hard-soldering process with copper, brass, etc. The Schoop reducing liquid is now applied with a brush, and the flame, which is regulated according to the thickness of the material, is then applied to the metal. Aside from the application of the reducing liquid, the process of operation is exactly the same as in the case of the well-known process of lead burning.

The following table gives the cost of sheet aluminium soldering in which the illuminating gas-oxygen flame is used for heating purposes, the mixture consisting of about 2 parts of illuminating gas and 1 part oxygen:

Thickness of the sheet metal in inches	Mixture of oxygen and gas.		Wages in cents.	Total in cents.
	Cubic feet.	Cost in cents		
0.02	0.35	0.57	0.57	1.14
0.04	0.42	0.67	0.75	1.42
0.08	1 27	2.07	1.50	3.57
0.12	2.65	4.37	2.00	6.37
0.20	4.59	7 50	3.75	11.25
0.32	12.37	20.00	6.25	26.25
0.40	15.90	28.00	7.50	35.50
0.48	26.14	42.50	10.00	52.50

Illuminating gas at $1.12½ per 1,000 cubic feet.
Oxygen at 1.35 cents per cubic foot.
Labor at $1.50 per 10 hours.

The Current Supplement.

The first of three installments of an article on the manufacture of illuminating gas is published in the current Supplement, No. 1626. The first installment deals with the making of coal gas. Mr. C. W. Parmelee writes on the technology and uses of peat. A very good monograph on corn-harvesting machinery is also published. Henry H. Quimby writes on concrete surfaces. Prof. F. B. Crocker and M. Arendt discuss the advantages and applications of the electric drive. The second installment of the article on the utilization of waste materials is published. The black sands investigations of the United States Geological Survey are described and illustrated. The English correspondent of the Scientific American writes on types of early steam engines still working in England. A few problems of the preserving industry are considered by Dr. E. Krüger.

THE MAGNITUDE OF THE GAS INDUSTRY.

Illuminating gas, which is piped into our buildings as freely as water, is the aeriform product of the destructive distillation of a liquid or solid hydrocarbon which may, or may not, be diluted by the admixture of other combustible gas or gases. Bituminous coal or petroleum, or some of the products of the fractional distillation of petroleum, form the basis of the manufacture of gas. Some idea of the size of the industry may be obtained when it is stated that in 1905 the total value of the raw materials used was $37,180,066. It is interesting to see how the materials are distributed. First we have the item of coal, 4,431,774 tons, costing $14,607,485; next we have 403,263,738 gallons of oil, which cost about the same, the sum being $14,531,585. Coke is a smaller item, 435,534 tons, costing $6,176,340. Vast quantities of water are required, no less than 5,430,361,158 gallons being used. Fortunately, water is not very expensive, $253,895 representing its total cost. Other materials amount to $6,176,340.

Our total cost was $37,180,066. Now, what is the value of the product? The hand of man—the chemist co-operating with nature by the use of the materials of her mineral kingdom—has succeeded in making a subtile aeriform mobile product, valued at $112,662,568 and occupying the enormous bulk of 112,486,783,148 cubic feet.

The product is divided both as to kind and value as follows:

	Cubic feet.	Value.
Straight coal gas..........	12,674,033,691	$12,868,604
Straight water gas.........	715,550,006	832,440
Carbureted water gas......	54,687,118,030	48,071,180
Mixed coke and water gas..	40,980,413,950	45,605,263
Oil gas....................	3,397,456,873	5,141,460
Acetylene gas.............	7,880,666	104,267
All other gas.............	24,329,932	39,354

Not only do we have these valuable gases, but we have by-products as well. Coke, valued at $5,195,461, represents 89,146,434 bushels; while $2,064,343 stands for the value of 67,515,421 gallons of tar. All other products are worth $972,992. A considerable revenue is derived from rents and sales of lamps and other appliances, such as stoves, the amount of this business being $4,249,581.

Comparison of raw materials and the product are always interesting, and especially so in the case of gas, where a graphical representation becomes positively spectacular. The total amount of gas of all kinds produced in the United States for 1905 would fill a gasometer 5,829 feet in diameter and 4,556 feet high. Assuming that a gas engine consumes 92 cubic feet of gas per hour, being the mean between a minimum consumption of 70 and a maximum of 115 feet per hour (Mathot's figures) this quantity of gas would run gas engines having an aggregate of 407,560 horse-power ten hours a day for 300 days. According to the Twelfth Census, there were 14,884 gas engines, which furnished 143,850 horse-power, a pitiful percentage of 1.3 of the total horse-power. Since this enumeration the number of gas engines in use has been materially increased; but even so, the great bulk of gas is used for illuminating and heating purposes.

A comparison of the yearly production of gas is unwieldy, owing to the lack of objects with which to compare. The Eiffel Tower would look lost compared with a gasometer 4,556 feet high, so we have taken a week's supply, which amounts to 2,163,207,368 cubic feet. This enormous bulk is shown in our engraving stored in a huge gasometer 1,620 feet high and 1,350 feet in diameter. The water is contained in a tank 241 feet high and 268 feet in diameter. The raw materials are also of a bulky nature. The coal would form a cone 268 feet across at the base and 200 feet high. The coke also forms a cone 120 feet high and 160 feet across the base. The oil would fill a barrel 155 feet high and 122 feet in diameter.

For the benefit of our readers, we are publishing in the Supplement an elaborately illustrated technical article on the production of both coal and water gas. There is nothing which is more conducive to comfort than this colorless aeriform fluid, which is brought to our doors and consumed for light and heat, our comforts.

Correspondence.

Eyeglasses as Telescopes.

To the Editor of the Scientific American:

In the Scientific American of December 29, 1906, page 484, appears an article on the use of a single lens as a field glass. I have made use of this principle for a long time, and it may not occur to many of your readers that they themselves have the necessary lens, with the proper correction for their eyes, ready for use at any time. I wear a compound lens, +.50 +.25 —90 deg. By holding this at arm's length, objects appear about one-third larger. Being able to use both eyes, and having each eye see through the *center* of its own lens, is a great improvement over using a single lens.

The easiest way to get objects in focus is to take the glasses from the nose, and while looking at the object through the glasses, extend the arm to full length, taking two or three seconds' time for the movement. In this way the object is easily centered, and the eyes are not strained.

I have made out the names of boats in a race, that without the glasses extended showed only by the difference in the color of the paint. Once when my arm was not long enough to get the desired magnification, the glasses were hung on a twig, and by getting about five feet back, the result was satisfactory.

Near-sighted people, and perhaps those wearing very strong plus glasses, cannot make use of this method, but there are many others who can.

John V. Frederick.

Lancaster, Pa., January 2, 1907.

"The Battleship of the Future."

To the Editor of the Scientific American:

I was much interested in the article on the "Battleship of the Future" accompanied by sketch designs. The particular arrangement of turrets arrived at by the author, however, seems to me to be open to grave objections. The concentration of the weight of four turrets and the large barbette on a small area, itself not coincident with the area of maximum buoyancy, would produce enormous shearing forces, which in turn by their integration would give rise to great bending movements.

To resist these severe stresses it would be necessary to give the hull considerable local reinforcement near the turrets, and to provide the structure as a whole with excessively heavy longitudinal members.

The weight involved in these arrangements would probably balance the weight in armor saved by the peculiar location of the turrets.

The very arrangement of the barbette makes it difficult to secure proper continuity of the longitudinal strength, as it apparently cuts all the upper strength members except the sheer strake. Even supposing it were possible to build such a vessel, the design would not be practicable for the reason that the author has left the sheer strake entirely unprotected by armor. Now suppose she engages in battle in a moderate sea; a few high-explosive shells amidship would cut up her sheer strake, deck stringers, etc., and it is quite possible that she would break in two under the action of the waves. In the Japan Sea battle the shells tore huge gaps in all structural plating wherever exposed, and I think this design would be extremely vulnerable under these conditions.

Another important consideration is the location of the handling rooms, which are of course vertically under the turrets. The author does not take up this question, but it would be necessary to have either a single large room, or several smaller ones close together; and further, the handling rooms would extend well outboard on either side. Now a single torpedo explosion near this point, a single accident in the handling room, or a single 12-inch shell, would put all the turrets out of action—if, indeed, the adjacent magazines were not detonated, and the whole ship destroyed.

I believe that the battleship of the future will carry twelve 12-inch guns in six turrets on the center line.

The center line of the ship is the proper location for a turret, since there the guns command the maximum arc of fire, the magazines and handling rooms are kept inboard—a very important point in these days of the perfected torpedo—and the deck stringers and other important members are not cut. George B. Moody.

Bath Iron Works, Bath, Me., February 15, 1907.

To the Editor of the Scientific American:

After reading Mr. Cardullo's discussion of "The Battleship of the Future" I beg to say that while his facts and arguments are intensely interesting, and really valuable, he seems to fail to comprehend fully the work for which battleships are designed primarily—or ought to be designed.

Battleships are not built to resist attack. They are built to attack and destroy the enemy. Speaking of speed, Mr. Cardullo says "the faster ship may theoretically choose her position and range, but if she is overmatched in guns and armor at all ranges her only choice is to run." That is true, but what he ought to have said—what it is infinitely more important to observe—is that if she is overmatched in speed her only choice is to let the enemy run away, no matter what guns or armor she may carry. And if she is overmatched in speed and guns her only choice is to surrender (or sink), no matter what armor she may carry. For, as Mr. Cardullo shows clearly, the thickest possible armor can be penetrated by the 12-inch gun at any fighting range.

Every American designer of battleships ought to hang up two mottoes in his workshop: "Remember the 'Essex'!" "Remember Farragut!" For the "Essex" was captured at Valparaiso because she did not have enough motive power to enable her to get within range of the "Phoebe." If we are to remove the eagle from our shield and put the porcupine or the terrapin in its place—if we are to wait for the enemy to come to our harbors to do the fighting, and when there to choose his time of fighting and his range—then speed is of less importance than armor. But the men in our navy who can be trusted to defend our country by forcing the fighting, are a unit in demanding ships that will have, first of all, power to reach the fighting line in spite of the enemy's modesty; and when there will have guns to demonstrate the truth of the immortal words of Farragut: "The best protection against the enemy's fire is a well-directed fire from our own guns." JOHN R. SPEARS.

Northwood, N. Y., February 16, 1907.

The Scientific American in Syria.

To the Editor of the SCIENTIFIC AMERICAN:

It is becoming better known among scholars, that to the Arabs and to the Arabic language modern learning and modern civilization owe a great debt, not only because of the direct contributions of the Arabs to the sciences of mathematics, chemistry, astronomy, and metallurgy, but also because they saved for us and transmitted to us so much of the learning of the ancient Greek civilization. There was a time when the "glimmering light of knowledge was all but ready to die out," and would have done so but for the Arabs. Many of the noblest scientific works of antiquity had disappeared from the languages in which they had been written, and were saved to us through the Arabic. It was thus that the works of Plato and Aristotle and Euclid traveled by way of Bagdad, Bassora, Sicily, Cordova, and Seville into Europe.

Now I am sure that your readers will be interested to learn that you in your publications have for years been making a return in the nature of a partial payment of the debt we owe the Arabs, which has come about in this way: For more than forty years the American Presbyterian Mission in Syria has published a newspaper in the Arabic language called the Weekly Neshera, which circulates well over the Arabic-speaking world. It has always been an aim to give to its readers the latest and most accurate accounts of all discoveries in science, together with a record of the yearly advance of learning. We have found nothing to equal the SCIENTIFIC AMERICAN for this purpose, so that as a result it is well within the facts to say that during the forty years there have been translated from its pages into the Arabic as many as two thousand articles and paragraphs. In recent years the Arabic newspapers in Beirut alone have increased to as many as twenty, and these in turn copy most of the scientific articles, and give them a still wider circulation among Arabic readers. FRANKLIN E. HOSKINS.

Beirut, Syria, January, 1907.

Sweet Milk and Indigestion.

To the Editor of the SCIENTIFIC AMERICAN:

In a recent issue of the SCIENTIFIC AMERICAN I find an article concerning sweet milk, and I also find municipalities making war on dairymen, directly and indirectly accusing them of selling unclean milk.

In this connection, being myself a specialist in the treatment of indigestion, I would like to make known to the people and scientists through the SCIENTIFIC AMERICAN just what I have discovered in regard to sweet milk.

I find that thousands of people who are well and hearty seldom, if ever, drink sweet milk, whereas the majority of those who are sick, ailing, or chronic invalids drink it, many to an excess, and as a rule those who are the most ill drink the most milk. I also find in treating stomach trouble of years' standing that they cannot be cured unless sweet milk is withheld from the diet, but that they can be permanently relieved in a very few days if it is withheld. I do not wish to be understood, however, that abstaining from milk will cure chronic indigestion, but when sweet milk is used, the cure is apparently impossible.

One instance: A patient was sick for years with what is known as dyspepsia and prolapsus in its worst form. Former physicians gave her largely a diet of sweet milk, but she received no benefit for either complaint. On beginning my treatment, I had her abstain entirely from sweet milk, not even taking cream in coffee, and in a fortnight she had recovered from nearly all ill effects of indigestion, and possessed the ability to digest three hearty meals per day, and was soon entirely well of both complaints.

Just why sweet milk has this effect in stomach trouble I cannot say, but would like to find out.

Yet I know a great many physicians prescribe a sweet-milk diet in treating dyspepsia and other chronic ailments. CLAY HARPOLD.

Cleburne, Texas, January 18, 1907.

The West Indian Hurricane.

To the Editor of the SCIENTIFIC AMERICAN:

I note with interest Mr. Wilmoth's article in your issue of December 22, stating that the injury to timber, crops, and shipping in the West Indian hurricane of September 26 and 27 was due, not to the storm so interestingly described in your issue of November 24, but to another storm which blew in an opposite direction, i. e., northwest, as shown by the thousands of trees broken, all of which point to the southeast.

Mr. Wilmoth assumes that there were two storms, one from southeast to northwest (as stated in your article), the other from northwest to southeast, the edges of the two storms meeting or overlapping near the eastern boundary of Mississippi.

This phenomenon, which Mr. Wilmoth believes to be very rare, results from the well-known whirling of winds about a cyclonic center, the motion of the wind in a hurricane being closely analogous to the movement of water discharging itself by a vent at the bottom of a basin. If the water be given a slightly rotary motion before the vent is opened, the threads of liquid, instead of moving radially inward, will be deflected so as to form a rapidly whirling eddy or vortex of increasing velocity toward the center. The centrifugal force developed by the rapid whirling of the water on a small radius produces a distinct depression on the water surface at the center, and may become so great as to open an empty core.

In the foregoing, the top of the water represents the bottom of the atmosphere; the downward discharge of water corresponding to the convectional ascent of the air, and the whirling escape of the water representing the whirling inflow of winds, moving gently at first, but increasing in velocity as the center is approached until a hurricane violence is attained, close to the central area of dead calm.

Because of deflection, due to the earth's rotation, these cyclonic winds move spirally inward toward the area of least pressure—in this hemisphere, in a direction counter to the motion of the hands of a watch; from which it is evident that the direction of the wind, at any point in a cyclonic system, depends entirely on the position of the observer with reference to the center of the storm.

If his position lies on the center of the storm track, he will note first a gentle southeasterly wind, gradually increasing in velocity and shifting somewhat to the south; the thermometer falling, temperature rising, and cloudiness turning to rain or snow. On the approach of the central area of least pressure, the velocity of the wind becomes excessive, and the centrifugal force increases at a rapid rate; then follows a period of comparative calm, the air being held away from the storm center by the excessive centrifugal force. Shortly after, the wind veers more or less suddenly to the northwest, increasing to hurricane violence as the barometer rises and the temperature falls. This sudden reversal of the winds is due entirely to the storm's progression, which brings the observer successively under different parts of the spiral whirl.

If Mr. Wilmoth will keep the above in mind, he will have no difficulty in identifying his two overlapping storms as integral parts of the hurricane of September 26 and 27, described in your issue of November 24.

Chicago, Ill. DAVID J. BLOCK.

THE MOTOR BOAT SHOW AT MADISON SQUARE GARDEN.

BY A. E. POTTER.

The First Annual Motor Boat Show, divorced as it was from the Sportsman's Show, which has come to be one of the fixtures of the late winter, closed last Tuesday night after a remarkably successful run of seven days and nights at Madison Square Garden, New York city. The Fourteenth Annual Sportsman's Show opened last Friday and will last until Saturday.

On entering the Garden, one was at once struck by the changed conditions. Rustic bridges and hand rails and decorations of firs were not in evidence, nor was there the tank that had been seen for two seasons previously. There was present, however, an air of business that assured success from the outset. Very little had been spent for decorations, fancy signs, etc., but there were numerous boats, engines, and accessories exhibited. Although many of the exhibits were meritorious, the Show was hardly representative of the industry, as many prominent and favorably known builders were absent.

The West was largely represented by both hulls and engines. New York and nearby motor-boat and engine builders were fairly numerous, while New England furnished but four or five exhibitors of either engines or boats.

The high development of the boat builder's art was reflected in a number of fine creations contributed by several well-known firms. These beautiful craft, finished in the natural wood and polished like mirrors, were carefully and critically examined and inspected.

The Michigan Boat Company and Detroit Engine Works, of Detroit, Mich., exhibited a line of boats at such low prices as to bewilder one who was familiar with the cost of construction of such craft, when laboriously contrived without the aid of up-to-date woodworking machinery and modern manufacturing methods. Their exhibit of knockdown frames was the only one of the kind in the Show, as was their power canoe. They also had on exhibition a knockdown frame assembled ready for planking. Their steel boats were also interesting and showed considerable development in this type of hull.

The Mullins Boat Company, of Salem, Ohio, had an unusually large line of their famous pressed-steel boats on exhibition. The one which attracted the most attention was a 35-foot by 7-foot day launch with torpedo stern, protected propeller, three-armed shaft strut, and balanced rudder. The six-cylinder engine was placed under a hood at the bow with the entire control attachments on the bulkhead, which divided the engine compartment from the commodious and well-arranged quarters amidship and aft. The steel used in this boat was No. 12 gage, smooth seamed, galvanized, and carefully riveted and soldered. The skin of the boat was not attached to her strong, bent, oak frames. The method of fastening the sides was novel and betokened great strength. The keel was of oak, to the bottom of which was bolted a heavy T iron. The sides were extended and riveted through the lower extension.

Mention should be made of the Atlantic Company's exhibit. These boats were built at Amesbury, Mass., and were remarkable for their apparent seaworthiness. Two were dories, while the third was a 23-foot open boat with canoe stern and dory bow. The dory may not strike the fancy of power boatmen all over the world, but in New England, where its value is appreciated from its utility and safety, its appearance meets with popular approval, and the use of the power dory is extending surely and rapidly.

The Williams-Whittelsey Company, of Steinway, L. I., showed an interesting collection of complete models, built to scale. This is the first time that models have been put on exhibition by motor-boat constructors. Two of the boats shown in this way were new ones now under construction, while the other two were boats already in existence, one of them being the U. S. coast defense inspection boat "Norka," which was illustrated in our Motor Boat number.

Among the interesting engines of the two-cycle type were noted several that showed considerable ingenuity in their design and construction. One of these, for example, was a 4-cylinder double-acting, vertical engine having explosion chambers at each end of the cylinders and compression chambers between. This motor was an extremely smooth-running and light affair. Still another interesting two-cycle motor was one in which a positively-actuated inlet valve was used for the introduction of the charge into the cylinder.

The exhibitor occupying the most space was the Truscott Boat Company, which had the entire eastern end of the Garden. This company showed its usual superior line of boats, and a decided novelty in engine construction. This was of the four-cycle type, with cam shaft mounted on top of the cylinders, driven by sprockets and a noiseless chain passing up inside the casting between the cylinders, which were cast in pairs. The cylinders had dome heads cast integral. The valves were of the removable cage type, and were operated by rocker arms. Some of the claims of this construction were extreme accessibility and conservation of power by reducing the loss from radiation to the minimum.

Another extremely interesting engine was the five-cylinder, air-starting Dock engine of 30 horse-power, now being built by the New York Safety Steam Power Company, of this city. In the accompanying illustration, which shows the inlet side of the engine, may be noted the air compressor and controller on the front. A reducing valve in the air-supply pipe is interposed between the air-storage tank and the fitting *I*, between the carbureter, *C*, and check valve, *V*. To start the engine air enters the fitting, *I*, passes through the carbureter, *C*, the check valve, *V*, preventing its escape, and enters the cylinders only when gas is taken into them in the usual cycle, that is, at each alternate down stroke of the piston. This is accomplished by means of a novel arrangement of the inlet valve here shown. There is a cylindrical bushing held in place normally by the inlet valve spring. This bushing has a sectional area greater than that of the valve head. When the air under pressure passes through the carbureter, it takes up its quota of gasoline vapor and enters the cylinders in the form of the usual explosive mixture. As it enters the valve chest the pressure bears on the balanced piston or bushing, forcing it