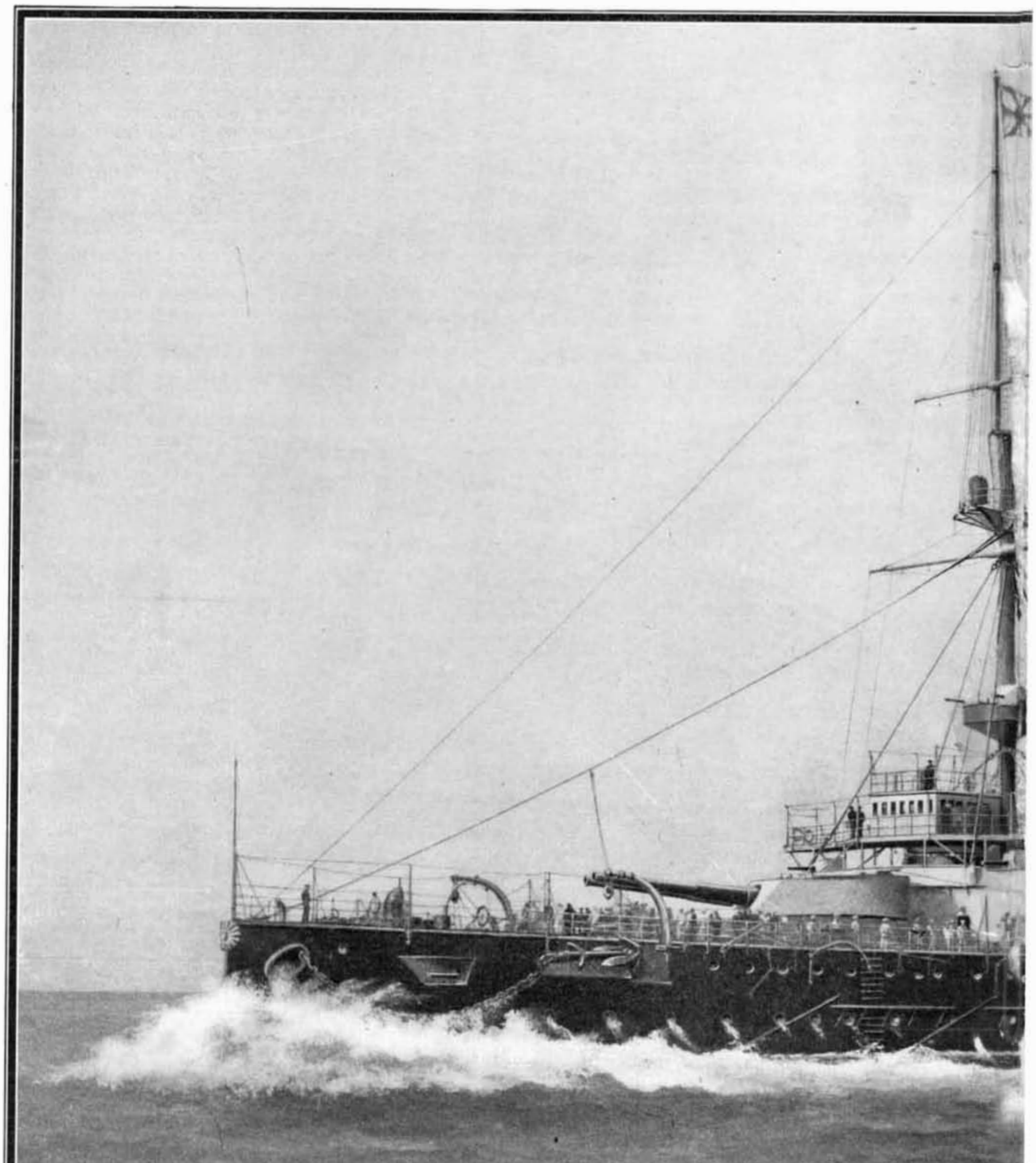
ADMIRAL TOGO'S FLAGSHIP "MIKASA."

Among the personnel and the war material of the Japanese naval forces that have been thus far engaged in the Russo-Japanese war, the most conspicuous units have been Admiral Togo and his great flagship the "Mikasa." Just as Port Arthur is the center and most important objective of the naval war, so the "Mikasa" is the central point around which revolve the various elements, battleships, cruisers, scouts, gunboats, and torpedo boats, in fulfilling their various duties in the campaign. What the tent of the ranking officer and the headquarters staff is to an army in the field, the admiral's cabin of the "Mikasa" is to the fleet of ships whose operations extend from Vladivostock to Port Arthur and from Newchwang to Nagasaki. It must not be supposed that an admiral of a fleet always selects the largest or most formidable fighting vessels for his flagship. Sometimes, as in the case of Admiral Sampson at Santiago, the choice is made of an armored cruiser, the "New York" having been in that case selected as the flagship, although there were five battleships, among which was the "Iowa," included in the blockading fleet. Usually it is the question of accommodations and of the speed and handiness of the vessel that determines the choice. In the present case, however, Admiral Togo's flagship is the latest and most powerful battleship in the Japanese navy, and she was probably fitted for use as a flagship at the time that she was built at the yards of Vickers, Sons & Maxim in Great Britain. The admiral's quarters are situated at the extreme after part of the vessel, on the main deck, below the quarter deck.

The Scientific American has made its readers familiar with the leading characteristics of the "Mikasa," and reference is made to the previous illustration of this vessel, showing her, bows on, at the moment when she is supposed to be leading the fleet into action. In that view she was shown with everything stripped. The accompanying illustration shows a quartering view from off the port bow. It represents the "Mikasa" when steaming at a speed of 18 knots, or over 20 miles an hour. The vessel has the following leading dimensions: Length over all, 400 feet; breadth, 76 feet; draft, 27¼ feet, and displacement, 15,200 tons. The length of the ship between perpendiculars is 400 feet. The "Mikasa" is modeled on the lines of the British 15,000-ton battleships of the "London" type, the chief difference being that she has 1 foot more beam and 1¾ feet less draft. She is a better protected ship than the "London," however, for the reason that those 6-inch guns of her intermediate battery, which are mounted on the main deck, are protected by a continuous wall of 6-inch armor instead of each gun being mounted, as in the case of the "London," in a separate casemate, with the stretch of the ship's side between the casemates entirely unprotected. This unprotected portion of the ship would allow the shells, which would be stopped by the continuous wall of armor of the "Mikasa," to pass through and burst in the interior of the ship between decks, at the risk of killing or maiming the crew and disabling the 6-inch guns on the opposite side of the ship. The "Mikasa" is protected at the water line by a continuous belt of Krupp armor, 9 inches amidships and tapering to 4 inches at the ends. With the side armor is associated a steel deck, which is 4 inches thick on the side slopes. Moreover, in the wake of the main turrets of the 12-inch guns, bulkheads of 14-inch Krupp armor extend athwartship to a junction with the barbette armor, so that projectiles which might enter through the unarmored ship's plating forward and aft would be stopped by the bulkheads and prevented from making a clean sweep through the ship. Extending from the top of the main water-line belt to the upper deck, and covering the whole space of the ship between the main barbettes, there is a continuous wall of 6-inch Krupp armor, which is pierced by gun ports on each side for the ten 6-inch guns, which are mounted on the main deck. Above this armor belt on the upper deck at the four quarters of the ship are four 6-inch guns mounted within casemates of 6-inch armor. The four 12-inch guns are carried in two barbettes of 14-inch armor, protected by hoods or light turrets, with sloping armor 10 inches in thickness in front and with vertical armor 8 inches in thickness at the sides and in the rear. The twenty 3-inch rapid-fire guns are mounted as follows: Two forward and two aft on the main deck; four on each broadside on the upper deck between each pair of 6-inch gun casemates; four on the roof of these casemates, and two on the forward bridge, and two on the after bridge. There are also a dozen 3-pounders and 2½-pounders carried on the superstructure bridges and fighting tops. Four 8-inch submerged torpedo tubes are provided, one on either beam in the wake of the forward barbette and one on either beam in the wake of the after turret. The ship is driven by engines of 16,400 horse-power at a speed of 18.6 knots an hour. She carries normally 700 tons of coal, but is able to stow 1,500 tons. An interesting feature is that no less than 4,600 tons of armor are worked into this ship.



Displacement, 15,200 tons; Speed, 18.6 knots; Coal Supply, 1,500 tons; Armor, belt 9 in., deck 4 in., barbettes 14 in., casemat

ADMIRAL TOGO'S FLAGSHIP, THE FIRST-CLASS BATTLESHIP "MIKA

The long-looked-for time has evidently been reached, when the siege guns of the investing Japanese armies could render the anchorages of the Russian fleet within the harbor of Port Arthur unsafe. It is probable that the high-angle fire from these guns was finding its way through the protective decks and threatening engine rooms and magazines. Hence the sudden sortie of the whole fleet in an attempt to reach Vladivostock or effect a junction with the armored cruisers from that harbor.

The fleeing ships were intercepted by the Japanese, and the results of the battle were fearfully disastrous to Russia. Not only was the attempt to effect a junction with the Vladivostock squadron frustrated, but the Port Arthur fleet was scattered and many of its ships so badly crippled that they must be stricken off the list of effectives. The "Czarevitch" has fled to the neutral port of Tsing-Tau, where she must be dismantled; the five other battleships are reported by Admiral Togo to have returned, badly damaged, to Port Arthur, where they will be again under the fire of the Japanese siege guns. Of the cruisers, the "Askold" is in the neutral port of Shanghai, badly crippled, and the other cruisers are not yet accounted for. The rout of the Port Arthur fleet is complete.

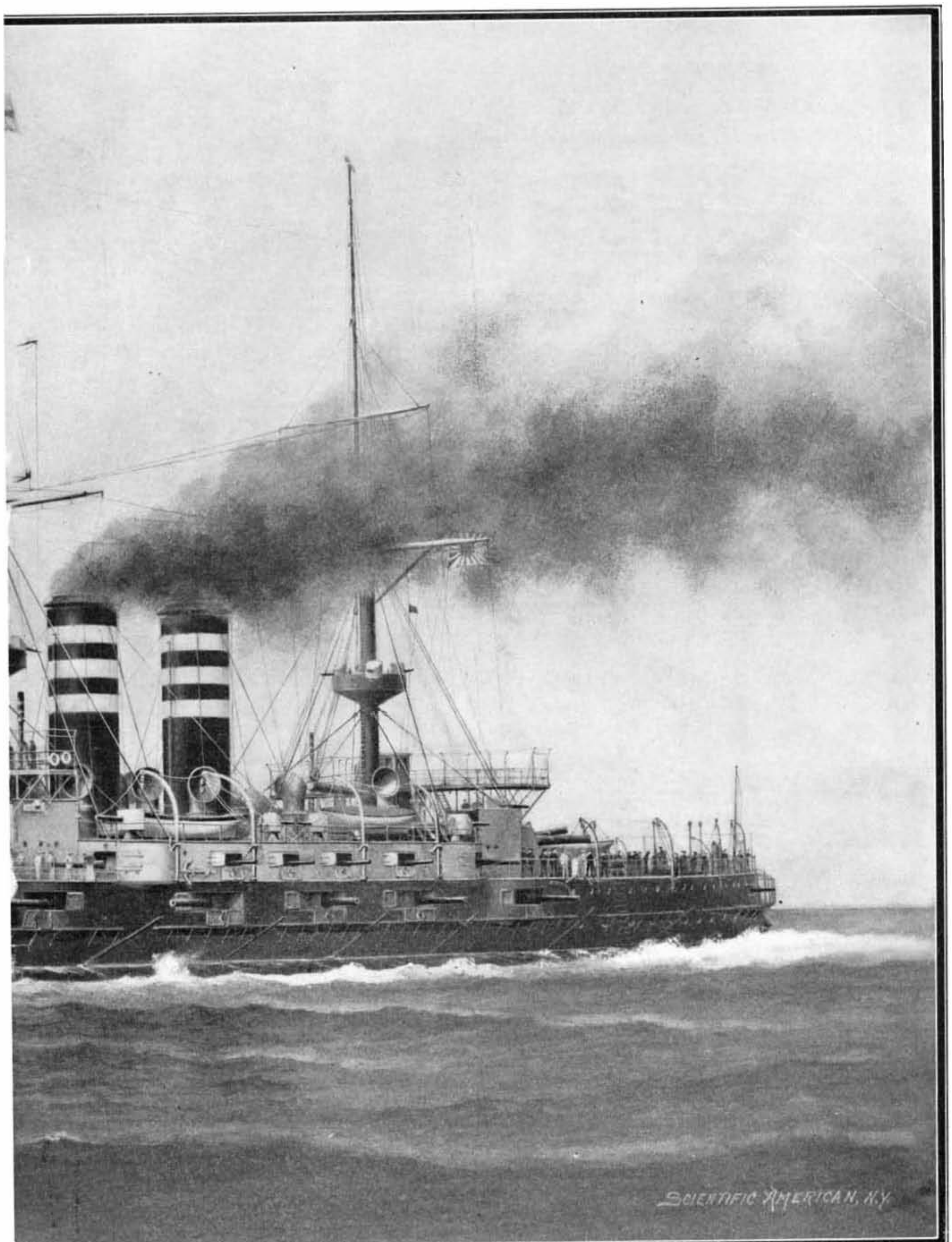
As we go to press, news comes of the defeat of the Vladivostock squadron by the ships under Admiral Kamimura. The "Rurik," of 10,940 tons, was sunk; the "Rossia" and "Gromoboi" fled to Vladivostock.

Atoms.

Sir Oliver Lodge, F.R.S., in view of the interest that is being manifested at the present moment concerning atoms, has contributed to the English press the following interesting popular description of the atom and how it is measured.

The idea of the atom is as old as Democritus and Lucretius, and it was revised and made relatively quantitatively definite by Dalton a century ago. An atom meant the ultimate indivisible unit or particle of matter indivisible either in the sense that no one knew how to split it up, or in the sense that if by any means hereafter it was ever subdivided, its parts would no longer correspond to what had been known as matter, but would be something new and unknown. A third sense might no doubt be foisted on the word, viz., that by no conceivable possibility could such a unit be ever subdivided; but that is an indefensible use of the word.

Take a diamond and crush it, pick out the smallest fragment and crush that, then with a microscope pick out the smallest particle, and, if you can, crush that further, and so on in imagination several times. You at length arrive, let us say, at a particle which is still a true diamond, but which, if you were able to take anything away from it, or to cut it further, would no longer be a diamond. That ultimate particle could be properly spoken of as a diamond atom. It need not be an atom of carbon—though a diamond is a crystalline form of carbon—because to form a crystal prob-



6 in.; Armament, four 12-in., fourteen 6-in., twenty 3-in., twelve small guns; Torpedo Tubes, four submerged; Complement, 730.

," FROM WHICH HE DIRECTED THE RECENT GREAT NAVAL FIGHT.

ably many carbon atoms are necessary. If the particle can be dealt with further, the next step would be to decrystallize it and reduce it to carbon, the smallest imaginable portion of which would be rightly called a carbon atom, provided the condition were fulfilled that if cut up any further it would cease to be carbon. The assertion that carbon is an element or elementary substance applies the idea that it is not possible by any known means to subdivide it. At the same time it would be legitimate to speak of carbon as an elementary substance, in the sense it was not composed of any known elements, and that it possessed a set of properties distinguishing it from other bodies called compound, without intending to signify that never could it be resolved into an aggregate of some unknown and purely hypothetical entity constituting a material substratum, or still more fundamental unit, of which other elements, too, could be composed.

In a very real and definite sense all matter is truly composed of atoms, just as a plant is composed of cells, and as a house is built of bricks. The bricks may, we know, be crushed to powder, but then they are no longer bricks. A brick—or at any rate half a brick—is in a sense the indivisible or ultimate unit of a house. A brick may be considered the molecule of which half a brick is the atom. One can imagine adamantine bricks which have been thought uncrushable, then the reduction to powder would be a discovery; but the name "brick" need not be altered, even though it had connoted indivisibility. Nor would it be convenient to style the particles of dust bricks.

Now about the absolutely quantitative aspect, or determination of the size of the atom, or enumeration of the atoms in the given weight of material. The real meaning of the phrase is a determination of the coarse-grainedness of matter. If matter were homogeneous and infinitely uniform throughout down to its minutest parts, there would be no meaning in the inquiry, and no meaning in the idea of atoms. Water, to the eye of sense, may seem to be in this predicament, but the atomic theory definitely asserts, and truly asserts, that that appearance is deceptive, and that it is ultimately granular, or composed of atoms, like a pile of cannon shot or of a granary of wheat.

Any laboratory process which gives a measure of coarse-grainedness will give an estimate of the size of atoms. There are a multitude of ways of estimating coarse-grainedness, and they all lead to the same result, that is, to a result of the same order of magnitude, not identically to the same precise figure, but to figures to which all are approximately equal within small discrepancies.

One method is by measuring the action of a block of transparent matter upon the waves of light. It does not transmit them all at the same rate; it transmits the big waves quickest and the small ones less quickly. We know this because if set obliquely it bends them differently, and so sorts them out according to size, giving what we call a spectrum, for the different-sized waves produce in our mind, through our eyes, the sensation of different colors.

The size of each wave of light is accurately known, and the different retardations which they undergo depends on the fact that the structure of matter is not infinitely finer-grained than the light waves themselves. Grainedness of structure is, in fact, the reason of the colors shown by mother-of-pearl, by finely-ruled buttons, by mist on a window pane, and also, though less obviously, by a prism.

But perhaps the simplest though not the most exact way of arriving at a rough estimate of the size of atoms is by measuring the thickness of a soap-bubble film, where it is as thin as possible just before it bursts. Such a film, if composed of atoms, must be something like a pebble wall. Now a pebble wall would not stand if it were not several pebbles thick, and if we had reason to suppose that it was about a dozen pebbles thick we could easily make an estimate of the size of a pebble by measuring the thickness of the wall. That is the case with the thinnest region of a soap film. It is found to have a very definite and uniform thickness. It is the thinnest thing known, and, by refined optical means its thickness can be accurately measured, in the same sort of a way as a flake of feathery glass can be measured; but, although so thin, it is as strong for a time as the rest of the bubble, for it stands the pull of the rest. It must contain not less than something like a dozen atoms in its thickness for this to be possible, and yet it is only about the twenty-millionth of an inch in thickness by direct measurement. So that the diameter of an atom comes out between one two-hundred-millionth and one three-hundred-millionth of an inch, or, in other words, from about 200 to 300 millions of atoms can lie edge to edge in a linear inch. This is equivalent to the statement that an apothecary's grain of ordinary solid or liquid contains a number of atoms comparable to nearly a million million million million—i. e., that the number is something less than a quadrillion per grain.

Any one line of argument or method of estimation may seem weak, but a number of separate and quite different methods, all leading to the same results, are like the strands of a rope, not like the links of a chain; and the approximate size of atoms has been known any time this last thirty years, chiefly by the arguments of Loschmidt, Dr. Johnstone Stoney, and Lord Kelvin.

As to the recently-discovered electrons, they are excessively smaller, but it is a great mistake to assert that thousands of millions of millions of them are to be found in each atom. If so, they would be packed closely together; and they are never so packed. A statement that an atom is big enough to hold this number if they were jammed into it truly represents their size, but not their actual distribution; in practice there are always spaces between them, great in proportion to their size. Though hydrogen is the lightest atom, and though the heaviest kind of atom contains 250 times as many, yet that number is not able to occupy more than a barely appreciable proportion of the whole available space inside the individualized region which we style an atom of matter.

In a note recently read before the German Physical Society, A. Gehrcke describes some experiments of some interest in connection with an observation made by Prof. E. Warburg, viz., that sulphuric acid, being normally decomposed by the electric current into oxygen and hydrogen, disengages at higher temperatures sulphur and sulphureted hydrogen at the cathode. In the course of an investigation into the spectrum of hydrogen, the author happened to observe that even at ordinary temperatures, besides the normal products, sulphureted hydrogen, sulphur, and sulphurous acid are obtained. This interesting phenomenon is best observed by means of a special apparatus allowing of any desired current density being produced on a pointed electrode. These phenomena are by no means connected with a given concentration of the sulphuric acid. For concentrations above or below those mostly used by the author (1:4 to 1:6), the same phenomena will take place, though requiring more time in order to be observed. As regards a possible explanation of these experiments, the author is not able to ascertain whether the latter are exclusively due to the rise in temperature occurring at the point of maximum current density. The high fall of potential which takes place at the same point could in fact equally play a part in these phenomena; and the latter would in this case exhibit a possible analogy with those observed in connection with discharges in gases.

The new main shaft of the Waihi gold mine in New Zealand was sunk 83 feet in eighteen days. The shaft is 32 feet long by 8 feet wide, and is timbered with 9 inches square sets, with lagging. The depth referred to was from 20 feet to 103 feet from surface, the shallowness being necessarily favorable to speed of sinking.

Mail Automobiles in Denmark.

The automobile commission recently sent abroad by the Danish government on a tour of inspection with a view to reporting as to the adaptability of the automobile for short-route mail service has just returned to Copenhagen. The commission is composed of officials from the post-office and other governmental departments and engineers appointed by the government. The following comments upon their work, which appeared in a recent issue of the Dannebrog, a leading Copenhagen daily, may be of interest to automobile manufacturers:

"The members of the commission visited a large number of places in north and central Germany, France, and England. The object of the commission was to investigate to what degree the automobile might be made a substitute for secondary railways.

"From what we have learned it was evident to the commission that the automobile offers the best of service in places where the modern machine has been employed in the public service. The automobile reaches its destination on time, and has advantages over the railway train, which often in foreign countries, especially in England, fails to arrive on schedule time. It is, however, only on the shorter routes that the automobile has as yet been introduced into the postal service.

"The greater number of foreign automobile manufacturers have hitherto paid little attention to the construction of automobiles for practical purposes. The few manufacturers who have, however, given special attention to this subject have been successful, as is evidenced by the cordial reception which the public has given the automobile omnibus, for instance.

"If speed were not a consideration, it was evident to the commission that it would not be advisable to replace the present stage service with automobiles. On the other hand, if quicker delivery is the main object, the automobile will best meet the requirements.

"It is the intention here in Denmark, possibly, to replace the day coaches (stage service) by automobiles. It will be required that the automobiles have a speed of about 12 miles an hour on the average, which is about the speed maintained in the public mail service in foreign countries."

The Danish government has recently entered into a ten-year contract with a local company for the delivery of mails over the stage routes in Denmark proper. This company proposes, with the consent of the post-office department and under its supervision, to install automobile coaches in place of horse-drawn vehicles. This is an important branch of the postal service, since there are so many small islands without railways. The passenger and freight traffic makes many of the routes quite profitable.

Four automobile omnibuses of French and, probably, German and Scotch manufacture will be given a three months' trial, beginning with September of this year. It is confidently expected that the experiment will be successful, and if so, that there will be a large demand during the next two or three years for automobiles of the omnibus type.

The following are the rather severe conditions to be met before any particular make of automobile will be purchased:

The body of the car (exclusive of machinery) must be approved by the commission. The machine must be run 2,000 kilometers (1,243 miles), after coming from the factory, at the maker's expense, an inspector appointed by the commission being on board all the distance. The car is then to be taken apart and each part carefully inspected, cleaned, and readjusted, and the car is to be run for three days at expense of maker. The car will then be forwarded to Copenhagen and run for three months by a driver furnished by the maker, who shall be accompanied by an agent of the commission. The commission will pay the salary of the driver, will furnish gasoline and oil, and provide housing for the car. The commission will pay one-third the price of the car on ordering it, one-third on its delivery in Copenhagen, and one-third at the end of the three months' trial, if it is found satisfactory. The trials are to be conducted under the supervision of the post-office department, and from their decision there is no appeal.

The car must accommodate sixteen persons, including the driver, and be capable of carrying 1 ton of freight besides, at an average speed of 12 miles an hour on a [illegible] per cent grade. The commission has practically determined to try the "Schneider-Creuzot" French omnibus, a car with a quadruple gasoline cylinder of 24 horse-power, costing $3,600, and accommodating twelve passengers inside and three on the platform. This car is at present most in favor with the commission.

THE IGUANA.

Among the interesting specimens brought back from the Bahamas by the expedition sent out by the Museum of Natural History of New York was a live iguana about three and a half feet long. This example of the *Pachyglossæ* was found on the Island of Andros where, as in the other islands of the group, the natives regard the animals as delicacies, hunting them by smoking them out of their burrows in the pine thickets.

The iguanas, a family of lizards, belonging to the sub-order mentioned above, comprise fifty-six genera and 236 species. With a single exception, all the genera of this extensive family belong to the New World, being especially characteristic of the Neotropical region, where they occur as far south as Patagonia, while extending northward into the warmer parts of the Nearctic region as far as California and British Columbia. The iguanas are characterized by the peculiar form of their teeth, these being round at the root and blade-like, with serrated edges toward the tip, resembling in this respect the gigantic extinct reptile the iguanodon. The typical forms belonging to this family are distinguished by the large dewlap or pouch situated beneath the head and neck, and by the crest, composed of slender, elongated scales, which extends in gradually diminishing height from the nape of the neck to the extremity of the tail. The prevailing color is green; and, as the majority of them are arboreal in their habits, such coloring may be generally regarded as protective. Those, however, which reside on the ground have much duller, though as a rule equally protective, lines. Iguanas possess to an extent exceeded only by the chameleon the power of changing their colors. Though the natives of the Bahamas claim that these lizards live on fruits and the tender shoots of plants, many scientists assert that they are insectivorous.

AN IGUANA BROUGHT FROM THE BAHAMAS.

Col. Renard, the chief of the French military aerostatic department, has devised a new type of marine boiler. For some years past this officer has been engaged in the designing of a specially light yet powerful motor for aerial purposes, and it was in the course of these experiments that he has designed this marine boiler. Col. Renard has laid it down as an axiom that the true solution of the problem of aerial navigation depends upon the construction of a motor which shall not weigh more than one kilogramme per horse-power. Although he has not yet succeeded in building an explosion motor conforming with this condition, he has succeeded in designing a steam engine, the weight of which he has reduced to 1.5 kilogramme per horse-power. The particulars of the boiler are preserved a secret by the French government, which has procured the invention and is now developing it, since it means an economy of 75 per cent both in weight and space as compared with the ordinary type of steam generator. Col. Renard has built one of these boilers of 80 horse-power, the weight of which is only 120 kilogrammes, and so satisfactory has it proved under test, that he is now engaged in the construction of two marine engines, one of 1,000 horse-power and the other of 1,200 horse-power, weighing 1,500 and 1,800 kilogrammes respectively, for trials in torpedo boats. Another advantage of this type of boiler is the economy in the consumption of fuel. Gasoline is used at the rate of only 434 grammes per horse-power hour. Steam is raised in seven minutes, and full pressure in fifteen minutes, while scarcely any heat is lost by radiation.

New Method of Manufacturing Steel.

It is reported that successful experiments have just been made by the Iron, Steel and Metals Manufacturing Company at Melbourne, Victoria, for the purpose of proving the value of certain patent rights for the direct production of wrought iron and steel without first producing pig iron. Only a rough idea of the process may at present be had, though trial runs with New Zealand magnetic iron sand are now being made on a somewhat larger scale than hitherto. The sand is first separated from its gangue by electro-magnetic separators, this treatment leaving a pure magnetic iron oxide. The sand is then fed from a bin into the furnace, which is entirely novel in its features, being chiefly mechanical and automatic in its operation.

The ore drops from the bin into a slowly revolving cylinder placed at such an angle that the ore travels forward continuously in it. As it does so it is heated to a dull red by the waste gases from subsequent operations. From this cylinder the ore drops into a second revolving cylinder, where the fine particles are subjected to the action of reducing gases which reduce the magnetic oxide of iron to the metallic form, at the same time permitting the particles to retain their individuality. From this second cylinder the reduced ore drops into a smelting bath at the bottom of the revolving cylinders, and the molten steel or malleable iron, as the case may be, is tapped from this whenever that operation is necessary. It will thus be realized that the process is one of great simplicity and yet of much ingenuity. Not the least interesting part of it is the use of fuel oil for heating purposes. This is employed to secure concentration of heat and direct application in the furnace work. It is found that the fuel oil possesses many advantages over producer gas as used in existing smelting practice. The work done so far has demonstrated that not only is oil a cheap fuel, quite irrespective of the capital outlay that would be required if it was decided to utilize producer gas, but it is so thoroughly under control as to insure the best service.

The temperature at which iron ore melts is given variously at from 1,500 deg. to 2,000 deg. C., according to its purity.

The accurate gaging of temperature in the furnaces plays a very important part in the company's work, and accordingly an installation of thermo-electric thermometers has been made at the company's works. The apparatus consists of a "couple" consisting of a platinum-iridium junction inclosed in a metal tube fully 3 feet long, which is placed in the center of the furnace, and the temperature is then recorded on the dial of a special form of voltmeter, each division on which represents 25 deg. C. This voltmeter reads up to 1,600 deg. and is placed at any convenient distance from the furnaces. The various thermometers are connected with a switchboard, which is again connected with the "couples" or tubes in the furnace. In the installation under notice four "couples" will be used, inserted in different parts of the furnace, and separately connected with the board, so that the reading of any thermometer can be taken and any discrepancy in the heat of different points of the furnace can be quickly remedied. It is interesting to notice that the voltmeter is so extremely sensitive that variations of heat down to 0.5 of a degree were easily noticeable in the trial test. The greatest temperature recorded was 1,300 deg. C., equal to 2,340 deg. F. —John P. Bray, Consul-General.

A direct railway between Shanghai and Canton presented so many difficulties, on account of the mountainous region to be traversed, that some Belgian engineers conceived the idea of making a branch from Shanghai, by Hangeschan and Nantschan, to Tschanscha, capital of Hunan, where it will join the Canton and Hankow line. The Frankfürter Zeitung states that the concession is granted.

The Great Northern Railway has now fitted five sets of Ransomes and Rapier's hydraulic buffers at its King's Cross Station. These buffers, together with five similar sets just installed by the Caledonian Railway at the Central Station, Glasgow, are the largest of their kind yet constructed; their pistons have a stroke of 7 feet. In tests carried out at King's Cross a train, weighing with engine 369 tons, was run into one of these sets of buffers at a speed of 9.4 miles an hour, and by their action was smoothly brought up without serious inconvenience to people seated in the carriages.