THE ZEROGRAPH.

It seems to be de rigueur that a fantastic name should be given to new instruments destined to be brought to the attention of the general public. The zerograph does not merely write ciphers, but is capable of transmitting the same number of letters and symbols as any other type-printing telegraph. However, a fancy name seems essential in this case, for to call the instrument the Kamm type printer, when one of its most important claims to attention is the absence of clockwork, would have been a comical error.

The general appearance of the instrument is shown in Fig. 1. Its overall dimensions are approximately 18 inches by 20 inches by 17 inches high. The keys, 36 in all, are not arranged in alphabetical order, but those most often required, i. e., those letters placed near the center of a typewriter keyboard, are put at the extreme left, the figures and stops which are less frequently used being at the right hand side. The reason for this will be explained presently. The most interesting part of the instrument is, as usual, the synchronizing device, and its action will be gathered from the following description and a reference to Fig. 2. The keys, A, of which one is shown in the diagram, are connected to vertical pins, B, arranged in the arc of a circle at right angles to the plane of the paper. The center of this circle is the axis of an arm, D, termed by Mr. Kamm the synchronizing arm. Normally this arm is held at a fixed starting position to the left of the arc of pins by a catch, and when the catch is released the arm is capable of swinging through the arc of a circle just above the pins already referred to until it is stopped by one of these rising. The impulse is given to the arm by a dropping weight connected to it by a cord passing over a pulley. The instruments at the two ends have exactly similar weights and synchronizing arms, a screw adjustment being provided; by this means the space through which the impulse-giving weight drops can be varied, so that the speed of rotation at either end of the arm can be slightly altered if it is not in exact agreement with the other end. The weight acts on the spindle through a pawl, so that it only acts during the forward swing of the synchronizing arm. Two current impulses are sent to line, the first releasing the catch and starting the synchronizing arm, and the second stopping the arm when the letter comes in a position for printing. The types are mounted on flat springs in the arc of a circle corresponding to that of the pins and fixed to the same spindle as the synchronizing arm, and the printing is effected by a plunger pushed forward by the printing magnet, which presses the type against the paper tape. An ink ribbon is employed in the usual manner, this being continuous and passing over two ink pads on the circumference of two rollers.

The arm, D, carries two projections, F and G, moved by the magnet marked "synchronizing magnet" in Fig. 2. The projection, G, is arranged to engage with any pin, B, as soon as this is raised by depressing the corresponding key, A. The other projection, F, engages with a hook, C, attached to the armature of the "starting magnet," and this catch holds the synchronizing arm in its initial position until the magnet is energized. On depressing any key, A, a contact at H is made as the key moves down, closing the circuit of the starting magnet and allowing the synchronizing arm to start on its journey. The lever attached to the key also makes a contact between K and L, and the starting magnet closes a contact at J; it will be seen that these two contacts connect the line battery to line. The line current passes through the synchronizing magnet at the other end, the armature, M, is [illegible], F is re-[illegible] and the [illegible]onizing [illegible] that end also starts. When the synchronizing arm at the sending end reaches the pin, B, of the letter required, it is stopped by the pin, and closes another local circuit energizing the "second contact magnet" and the printing magnet. The former of these lifts its armature, making a contact at O, and sending another current impulse to line. This second current again energizes the synchronizing magnet at the other end, the armature of which moves the projecting fang, G, so as to stop the synchronizing arm at the nearest spring-pin. This pin must correspond to that at the sending end of the line, if the two arms move with equal velocity. The same local circuit at each end is therefore closed, and the printing magnets press the type against the paper. At the same time the paper is fed by the usual mechanism, and the circuit of the "zero magnet" is closed at N, this magnet returning the synchronizing arm to its initial position. We believe that an arrangement of condensers and resistances are connected across the contacts in the local circuits, to diminish sparking.

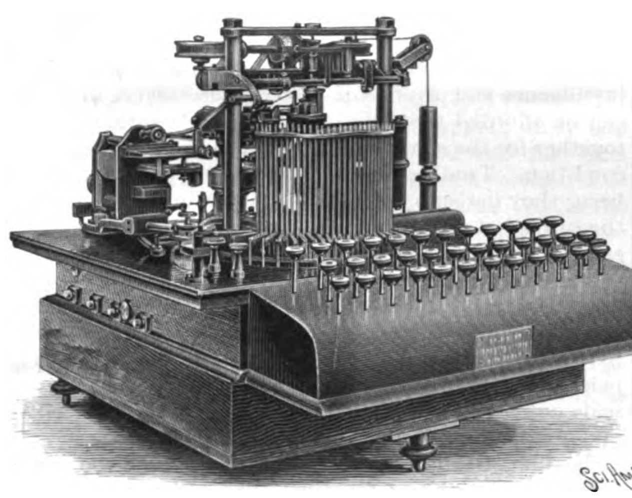


Fig. 1.—THE ZEROGRAPH.

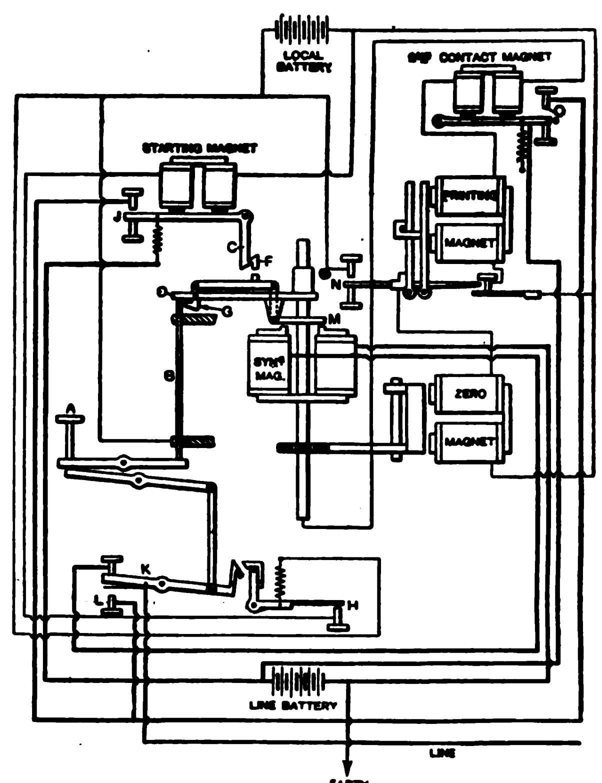


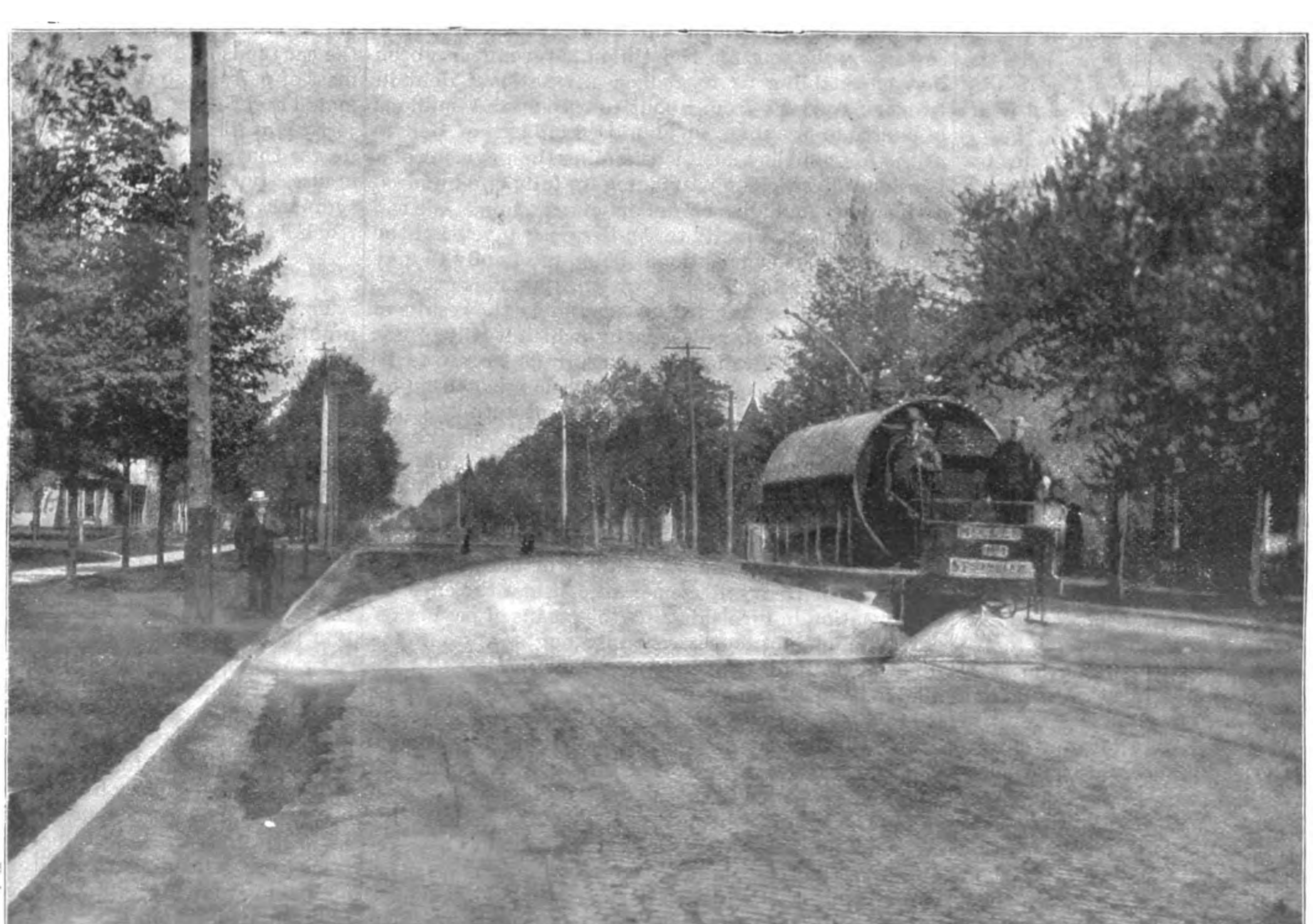
Fig. 2.—DIAGRAM OF CONNECTIONS IN THE ZEROGRAPH.

In point of speed the zerograph, although not competing with the Hughes type printer, is, it is seen, far beyond instruments of the step-by-step type, of which latter the "telescriptor," described in the SCIENTIFIC AMERICAN of January 1, is an example. The synchronizing arm takes but half a second to swing to the limit of its travel and back; and as the letters most frequently used are placed to the left, at the first part of the range of the synchronizing arm the average time per letter is but a very small fraction of a second; in fact, it is claimed that the instrument can transmit 25 words a minute. As evident from the description, however, everything depends on the accuracy with which the speed of the two synchronizing arms agree; and although the spindles are mounted on jewels, and the instrument shows most careful and workmanlike finish, time only can decide whether in this important respect no trouble is likely to be experienced. We understand that experiments have been made on long artificial lines, but no actual trials on long telegraph lines. The synchronizing magnet is very sensitive, and a 12 milliampere current suffices to work it, but we should expect that on long lines with considerable distributed capacity some method of curbing will be found necessary to insure the first current impulse being completely wiped out before the second occurs. It is essential that each impulse should take the same time to reach the other end, but the time elapsing between successive impulses varies with each letter.

Mr. Kamm has also devised a "column printer," in which paper of a certain width is used instead of tape. To commence a new line a key is pressed which is not connected to any of the circle of pins, and the synchronizing arm swings right to the end of its travel, closing a contact there which completes the local circuit of an extra electromagnet. This magnet moves the paper forward, and at the same time brings it back to the commencement of the line. This type of instrument is, however, not beyond the experimental stage, so that a detailed description of it would be out of place now. For our engravings and the description we are indebted to The London Elect[r]ician.

AN ELECTRIC STREET RAILWAY SPRINKLER.

We present an engraving of an interesting trolley sprinkling car which is designed to sprinkle the streets from curb to curb. It is very essential in many of our wide streets and boulevards to sprinkle the entire width of the street at one operation, and the car which we illustrate do[es] it very effectuall[y]. The sprinkling wagon of to-day is a great improvement over those formerly in use, on account of the ability of the driver to judge and determine instantly how much water to put on the pavement to sprinkle it properly and not flood it; but sprinkling with an ordinary horse tank wagon is expensive, owing to the fact that its capacity is small, requiring frequent fillings, and the cost of maintaining horses is very heavy. Many of our modern trolley lines are miles in length, and, with a car like that shown in the illustration, many miles of streets or roads may be sprinkled with economy and dispatch. The trolley sprinkler



THE MILLER ELECTRIC WIDE SPRAY SPRINKLING CAR.

SCIENTIFIC AMERICAN

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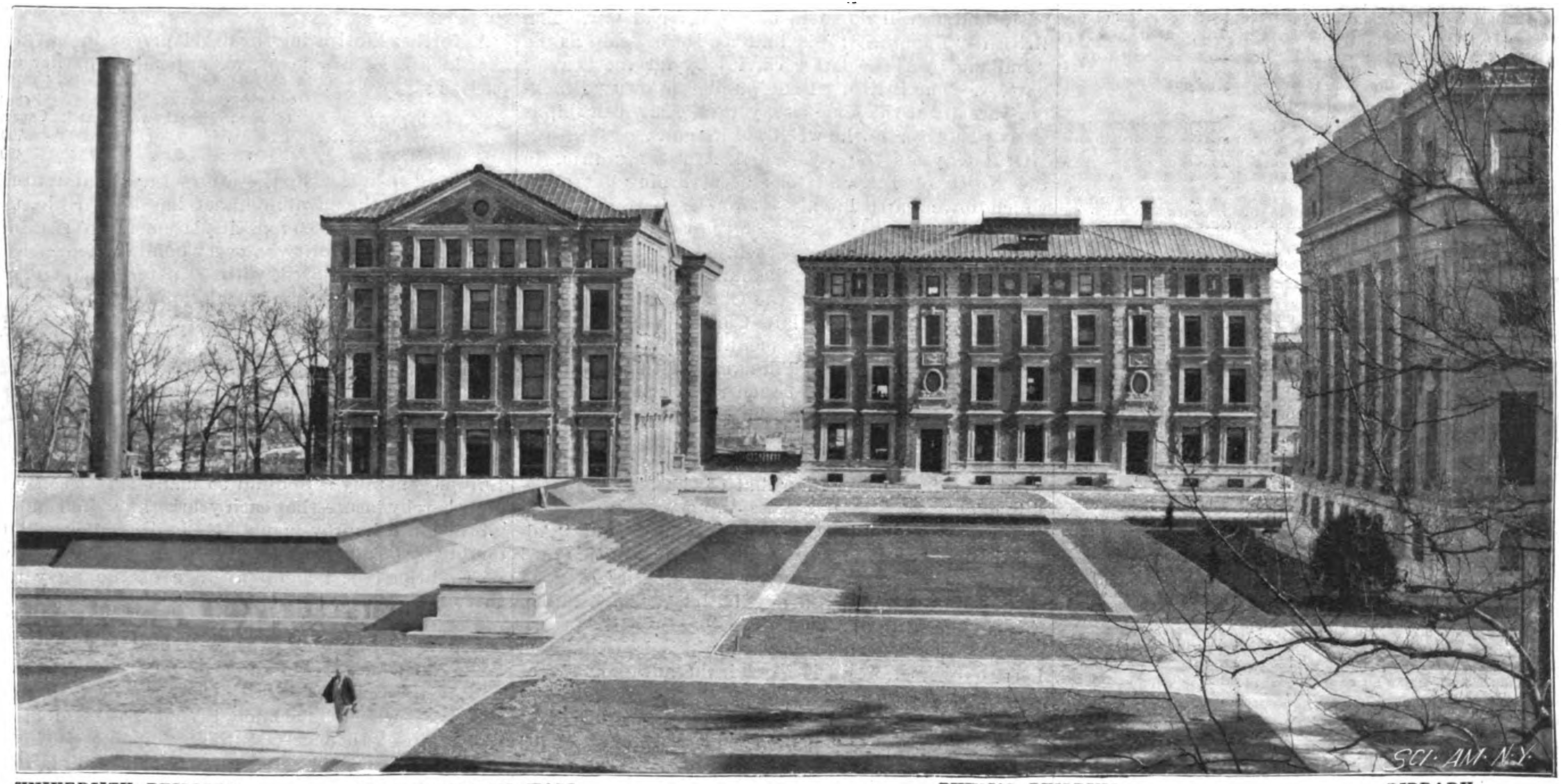

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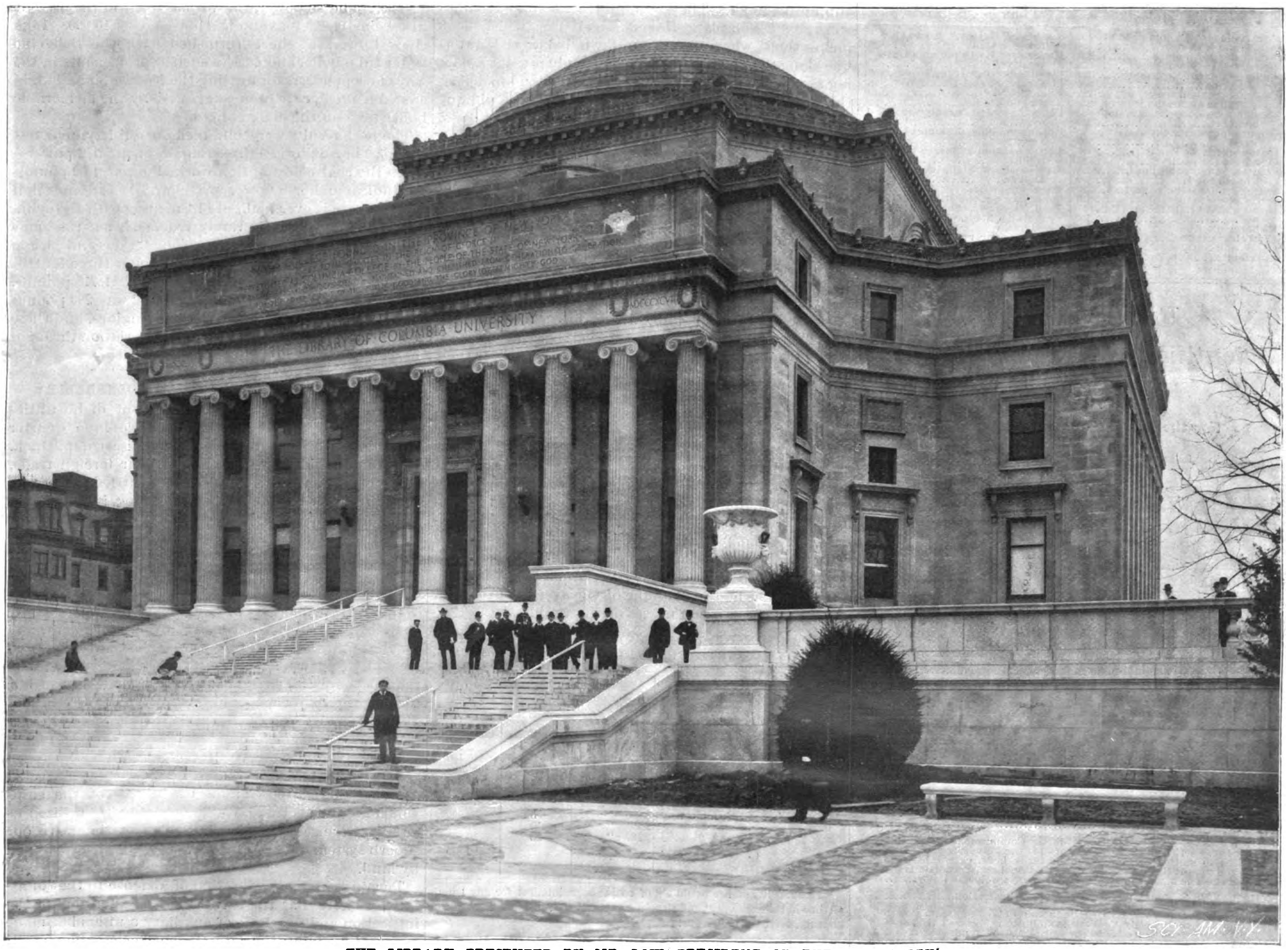

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(Illustrated articles are marked with an asterisk.)

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Scientific American Supplement

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OUR RECENTLY PURCHASED WARSHIPS.

It may safely be said that Armstrong's is the only shipbuilding yard in Europe where we could have purchased two cruisers whose general features so closely approximate to the distinctive features of warship design as carried out in this country. From time immemorial American ships have been celebrated for their speed, and even more for the great power of their batteries. This was true in the days of the sailing frigate, when our ships were wont to crush their opponents with the weight of their superior gun-fire and their excellent marksmanship, and the same powerful batteries are found on the ships of our new navy. The principle is a good one. It has proved effective in the past, and it will do so in our next naval war. The British "Magnificent" is half as large again as the "Indiana," yet the latter carries by far the heavier battery. The British "Blake" and our own "Brooklyn" are about the same size, yet the American ship is greatly superior in the weight of its guns.

Of late years the celebrated Armstrong firm, in the North of England, has been turning out ships which have carried truly enormous batteries compared with the displacement of the ships, and, at the same time, have shown themselves phenomenally speedy. The most noted instance of this is the renowned "Esmeralda," of the Chilean navy—not the old "Esmeralda," of the late Chilean war, but a new cruiser of 7,000 tons displacement. This vessel carries no less than eighteen rapid fire guns of the 8-inch and 6-inch sizes, besides eight 3-inch rapid firers and ten 6-pounders. From these guns she could pour into an enemy from either broadside during the first few minutes of the fight an amount of shell-fire whose total energy would be far greater than that of the biggest battleship afloat.

Our new acquisitions, the "Amazonas" and "Admiral Breu," are the very latest product of this yard and they exhibit the characteristic qualities of good speed and abnormally heavy battery, comparing in this respect with our own "Cincinnati." The principal dimensions, etc., of these twin ships are as follows: Length 330 feet, beam 43 feet 9 inches, draught 16 feet 10 inches, displacement 3,600 tons. They have twin screws and engines, the horse power being 7,500 and the speed 20 knots. Their normal coal supply is 700 tons, though they have stowage room for much more, and could therefore proceed at low speed far from our coal supply stations and reach hostile waters with a supply on hand. They are protected from stem to stern by a complete Harvey steel deck which is 3 inches thick where it curves down below the waterline along the sides. This 3 inches would present a sloping surface to the enemy, which would tend to deflect the projectiles. If they were not deflected the oblique 3 inches would be equal to a vertical wall of say 5 inches of Harvey steel. Before the shells could reach this deck, however, they would have to pass through 6 or 7 feet of coal which is stored in the wings of the ship abreast the engine and boiler rooms.

The battery, as we have said, is, for the size of the ship, very powerful. It is not only powerful in numbers, but owing to the fact that its guns are of the latest Armstrong pattern, they have vastly greater power for their size than guns that were built only four or five years ago. Armstrongs are the builders of the wirewound type of gun, which has shown results greatly superior to those obtained by the built-up type. Not only are these guns more powerful for their weight, but they have improved breech mechanism which enables them to be fired with greater rapidity. The following comparison of the Armstrong ship with one of the same size and type built for the British navy from government plans shows clearly the greater fighting power of the former. The figures are taken from the official tables of the British navy and the firm in question. The speed of fire is that actually obtained by crews on board ships in commission. The "Intrepid" is one of a class of thirty ships built under the late Naval Defense Act, and though not so up-to-date as the "Amazonas," may be considered as a good example of the average protected cruiser of the existing navies of the world.

COMPARISON OF TOTAL ENERGY OF FIRE DURING ONE MINUTE FROM EITHER BROADSIDE.

	Number and Size of Guns.	Muzzle Energy.	Shots per Minute from Each Gun.*	Total Energy.
"Amazonas," 1897	Four 6-inch.	4,840 foot tons	6	116,160
	Two 4·7-inch.	2,158 " "	12	51,792
	Five 2·24-inch.	280 " "	20	28,000
				195,952
"Intrepid," 1892	Two 6-inch.	3,356 " "	5	33,560
	Three 4·7-inch.	1,494 " "	10	44,820
	Four 2·24-inch.	137 " "	20	10,960
				89,340

* This rapidity of fire would not of course be maintained for any length of time in the excitement and slaughter of a modern sea fight. The figures, however, serve for the present comparison.

From this comparison then it is evident that although the two ships are of the same size, the "Amazonas" can deliver from her broadside more than double the energy of shell fire that the "Intrepid" can, although the latter ship was built only five years in advance of the former—such is the rapidity with which naval science and construction advances.

Foot-ton energy, which we have chosen as the basis of comparison, is the product of weight or mass by velocity; and as the weight of the shells for each caliber of gun is the same, the increase in energy is due to the very high velocities of the "Amazonas" guns as compared with those of the "Intrepid." Thus the 6-inch rapid fire Armstrong gun has a velocity of 2,642 feet per second, against 2,200 feet for the British naval gun; the Armstrong 4·7-inch gun has 2,630 feet per second, the naval gun 2,188 feet, and so on through the smaller calibers.

As further illustrating the development in naval design in a brief five years, we append a further comparison:

	Thickness of Deck.	Horse Power.	Speed.	Coal Capacity.
"Amazonas".........	3 inches.	7,500	20·00	700
"Intrepid".........	2 "	9,000	19·75	400

We find then that by the use of improved materials and methods the naval architect has been able, using the same capital (3,600 tons displacement), to produce a ship having superiority on every point of comparison—a ship with more speed, with 50 per cent better protection, 80 per cent larger coal capacity, and over 100 per cent more powerful armament.

We can imagine no more convincing argument for a systematic and continuous programme of naval shipbuilding than is presented by a study of these figures. The "Intrepid" was one of seventy-two warships which were authorized in a single appropriation and built with a rush. The present policy in England and Europe generally is to build so many ships each year, and thereby insure that each year's ships shall embody all the latest improvements. A similar policy will undoubtedly be adopted in this country, and its effect will be to bring the general average of the navy more thoroughly up to date.

THE EFFICIENCY OF THE WATER TUBE BOILER.

The efficiency of the water tube boiler needs no demonstration at this late day; but the coal consumption trials which have lately been carried out on the new cruiser "Diadem" are worthy of note because of the size of the boiler installation and the high economy realized. The "Diadem" is a smaller edition of the "Powerful," which was of 14,000 tons displacement and 26,000 horse power, the displacement in the present case being 11,000 tons and the horse power 16,000. Like the "Powerful" she is furnished with the Belleville water tube boiler and carries such improvements in the way of economizers for heating the feed water and higher steam pressure as were suggested by the memorable boiler tests on the older ship.

The best results were obtained on a thirty hour test at 12,500 horse power—three-fourths of the full power—when the coal consumption worked out at 1·59 pounds per indicated horse power per hour. It is doubtful if this low rate is ever realized in the navy with the cylindrical boiler, and it is rarely reached with the same type in the merchant marine. The "Powerful" using the same boiler burned 1·83 pounds on a three-fourths horse power trial and the "Terrible" 1·71 pounds. The steam pressure on the "Diadem" was 280 pounds at the boilers and 245 pounds at the engines, and these pressures were maintained with little variation throughout the trial.

IS OUR MARITIME COMMERCE VULNERABLE?

It is a fortunate fact that in the event of hostilities we should be practically invulnerable in a quarter where most nations would be open to disastrous attack. Great and rapidly increasing as is our foreign trade, only a very small percentage of it is carried in American ships. Although American shipping, inland, coastwise and deep sea or foreign, ranks in the aggregate next to that of Great Britain, we are secure from attack for the reason that the bulk of it is confined to the lakes and our great inland canal and river systems. As regards our foreign trade, for the year ending June 30, 1897, the proportion of foreign commerce carried by American ships was a fraction over 11 per cent, and for the month of December, the same year, it had decreased to about 7½ per cent. Thus it will be seen that in the fiscal year mentioned, for one ton of our commerce that was exposed to attack there were about nine tons which were safeguarded by the laws of neutrality.

Nor would our coastwise commerce, which is carried entirely in American bottoms, be so seriously affected as might be supposed; for the fastest of the sh[illegible] which are in this trade would probably be [illegible] auxiliary cruisers, and the merchandise, tha[illegible] superb system of seaboard railways, could be [illegible] by land.

Turning from the question of defense to tha[illegible] tack, we note that the Naval Board appointed [illegible] inspection and [illegible]hase of auxiliary cruisers has [illegible] a start b[illegible] late Ogden Goelet's fine y[illegible] the "May[illegible] [illegible]e fleet. This is a brand [illegible] vessel of 2,[illegible] about 17 knots speed. The


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