distances. In order to communicate at a distance of about six miles, it requires, it would appear, no less than one horse power.

The problem is, moreover, much more difficult than might be thought at first sight. The distance of transmission, in wireless telegraphy, as well known, depends before all else, upon the energy brought into play and upon the length of the antennæ. In this latter factor resides the principal difficulty. Tunnels, stations, and bridges prevent the putting of vertical antennæ of more than six or ten feet upon trains. In default of antennæ of considerable height, no other means therefore remains but to increase the energy brought into play. It is to a solution of this problem that experimenters in general are applying themselves. The difficulty might be surmounted, nevertheless, if horizontal antennæ could be effectively employed. But here a new difficulty is confronted. Antennæ placed one after another lose their efficiency. On the other hand, the displacements of the trains produce a respective displacement of each antenna.

As another method, it has been proposed to place along the track, and for its entire extent, a horizontal antenna, connected now with a transmitter and now with a receiver. Another horizontal antenna would be established upon the train and stretched, for example, over the roof of the cars. This system, it will be at once seen, has two disadvantages. In the first place, it necessitates a special wire and consequently involves a very great expense; and, in the second, it does not permit of a communication between trains. A truly simple solution, however, permits of conquering the difficulty, and this has been furnished by M. Guarini and his collaborators, M. Cesar and Lieutenant Poncelet. As may be learned from the Guarini and Cesar Belgian patent No. 167,023 of November 29, 1902, the system consists in employing an existing line of telegraph wires and using others as intermediate ones. For this purpose, there is produced at a point that may be fixed (station) or in motion (train), and that is situated near the said wires, an electro-magnetic disturbance by employing an oscillator, for example. Such disturbance is perceived, notably by means of a coherer, at another stationary or movable point placed near these same wires. These latter, in the first place, take up the waves and afterward radiate them. They therefore play the part of intermediate antennæ.

Some experiments with the Guarini-Cesar system have been performed upon the Belgian State line, have been watched by one of the latter's engineers, and have been crowned with entire success. The energy of 40 watts and an antenna of 4 strands of 32.8 feet sufficed to communicate between West-Saint-Georges and Ottignies, say a distance of 10.5 miles. With an energy of 15 watts, a spark of 1-10 inch, and a good coherer, signals were received at a distance of 2.5 miles, although the antenna of the movable station, arranged upon a small car, was one of but 6.5 feet. It consisted of an iron tube 4 inches in diameter. At the other station the antenna was 32.8 feet. Messages were received in both directions, from the car to the wire and *vice versa*, even when the car was at 100 or 130 feet from the telegraph wires. No disturbances of any sort were observed in the numerous telegraph and telephone receivers placed along the line. This fact is not wanting in interest, and agrees with the numerous researches of such scientists as Slaby, Turpain, and others, who have studied the simultaneous transmission of ordinary and high-frequency currents by means of the same wire.

In order to obtain such results, it was not even necessary to connect one pole of the oscillator, or of the coherer, with the earth. It sufficed to employ a condenser or even a simple capacity consisting of a tube parallel with the earth. Upon the car the ground connection was formed by the axles and wheels.

M. Guarini desired also to ascertain whether the rails might not perform the rôle played by the telegraph wires. With this object in view, some experiments were made after connecting the oscillator with the rails or with antennæ placed near the rail and parallel with it, as shown in our illustration.

With an energy of 100 watts and a sensitive Blondel coherer, MM. Guarini, Cesar, and Poncelet were enabled to receive signals, but at much shorter distances. The system in which telegraph wires are employed might, M. Guarini thinks, prove an economical means of constituting a block system with signals upon the locomotive. The inventor, moreover, from these experiments, draws some interesting conclusions, from a different point of view, but one that seems to have been the motive that led him to perform them. Submarine cables, which are insulated from the aqueous medium that surrounds them, might, perhaps, in his opinion, perform the rôle, in certain cases at least, of intermediate antennæ in wireless telegraphy to a great distance. In such a case, it would be very easy, he thinks, to assure by submarine cables, without interfering with their ordinary business, telegraphic communications between ships and with the coast. He does not favor, then, the bringing into play of the enormous amount of energy to which Marconi has recourse.

RUINS OF PIEDRAS NEGRAS.—ALTAR WITH HIEROGLYPHIC INSCRIPTION.

PIEDRAS NEGRAS.—SCULPTURED LINTEL FROM DOORWAY OF BUILDING.

PIEDRAS NEGRAS, A NEWLY DISCOVERED PREHISTORIC CITY IN GUATEMALA.

BY CHARLES C. WILLOUGHBY, PEABODY MUSEUM, HARVARD UNIVERSITY.

The region comprising the greater part of Guatemala, the western portion of Honduras, and the southern part of Mexico, including the peninsula of Yucatan, was the seat of an ancient American civilization highly developed and as interesting to the archæological student as any of the primitive civilizations of the Old World.

Throughout this region are found numerous remains of ruined cities, or, more correctly, ruins of religious and governmental centers; for religion and government were inseparable among this people.

The Spaniards, upon their arrival, found numerous books among the priesthood, each book consisting of many pages, the leaves being eight or ten inches in length and folded like a screen. The pages were covered with numerals, glyphs, and explanatory drawings beautifully executed in colors, which are supposed to refer to the calendar, to astronomical matters, and to religious ceremonies. The Spanish priests collected and burned every book they could obtain. Fortunately for students, three of the books found their way to European libraries. Their value is now appreciated, and they have been carefully reproduced by photo-lithography and are known under the titles of "Codex Dresdensis," "Codex Troano-Cortesianus," and "Codex Peresianus." Copies are now accessible to all students.

Upon the monuments and altars, upon the lintels, walls, and stairways, and upon the altar slabs within the sanctuaries of the temples are sculptured with elaborate detail hieroglyphs of the same character as those occurring in the codices. It is known that in many instances these hieroglyphs record certain dates by days, months, and longer time periods, but the significance of the great majority of the glyphs is as yet unknown. When they are deciphered, as they are sure to be in time, a flood of light will be cast upon the religious history of one of the most remarkable primitive cultures known.

With the view of bringing together reproductions of all the inscriptions upon the monuments of the Mayan peoples, the Peabody Museum of American Archæology and Ethnology of Harvard University has for several years had expeditions in the field conducting explorations among the ruins and making paper molds of inscriptions from which plaster reproductions have been made. While engaged in work for the Peabody Museum, Toberto Maler, long a resident of Mexico, heard of the existence of certain ruins in western Guatemala known only to the native wood cutters. After a long journey through tropical forests he reached the Usumacinta River, upon the banks of which the ruins lay.

The structures are built upon an irregular plateau or series of connected hills, artificially terraced. A transverse valley opens upon the river at the south of the plateau. At this point is a mass of blackish limestone rocks, visible for a long distance from the river in either direction, and called by the natives *Piedras Negras*. This name has been given to the ruins. Upon the flat surface of the largest of these rocks is sculptured a circle of hieroglyphs inclosing two seated figures. Entering the transverse valley

and climbing the slope to the north, the ruins of two temples were discovered upon artificial pyramids placed side by side. In front of each temple and upon the upper terrace of the pyramids stands a monument or stela of limestone. Upon the front face of the best-preserved of these has been sculptured with elaborate detail an inscription in Mayan characters. A gigantic stela broken in two pieces lies upon the lower terrace connecting the two pyramids.

Across the plaza to the northwest stands a third pyramid upon a natural elevation. The temple upon its summit is in ruins. A flight of stone steps leads from the plaza to a broad terrace in front of the pyramid. Six large stelæ stood in a row upon the terrace. Hieroglyphs cover the sides of these monuments, and upon the face of one is an inscription, the first few characters of which form the initial series and record dates in the complicated Mayan calendar.

Elaborately carved human figures, with explanatory groups of glyphs, cover the fronts of the remaining stelæ upon this terrace.

The sculptured stone lintel of the doorway to this temple has an inscription of eighty-one characters upon the upper half of its face. Below this is a group of figures illustrating the return of successful warriors with prisoners and plunder. The priest wears an enormous headdress covered with short, stiff feathers, from the back of which spring five plumes of the sacred quetzal. A short tunic with sleeves covers the upper part of the body, and below this fall the embroidered sash-like ends of the breech-cloth. He wears elaborate sandals with heel-bands coming well up upon the ankle. Beads encircle his wrists and neck. He holds in his hand a spear-like staff of office ornamented with feather work. Before him kneel two warriors with spears in hand presenting a pile of plunder, and a naked prisoner bound with ropes.

North of this temple the ruins lie for the distance of nearly a mile and a quarter, the terraces and the larger pyramids being fairly well preserved. Most of the temples are in ruins.

One of the most interesting of these is built upon the terraced side of a natural elevation upon the eastern side of the plaza at about the center of the ancient city. Ten stelæ and three great altars stand upon the upper terrace of the pyramid and upon the plaza below.

Of the ten stelæ belonging to this temple, the one standing at the southern end of the building and called "stela twelve" by Mr. Maler is of the greatest interest. This has unfortunately fallen and is broken into four pieces. Each piece was photographed, however, and the prints fitted together, making a perfect picture.

The great stone altars scattered here and there in the plaza and in front of the temples consist of oblong or circular blocks with hieroglyphs and occasional groups of figures. The altars are raised upon stone pillars, which are often sculptured upon their outer faces with inscriptions or are cut into the form of grotesque heads.

These ruins differ in many respects from the other ruins of Central America and of Yucatan. Piedras Negras was evidently the seat of a powerful military chieftain, as the sculptures everywhere indicate. The sculptured groups and figures of the ruins of Yucatan and of Quirigua and Copan are almost wholly of a peaceful, religious character, indicating priestly power and a growth in culture and wealth by peaceful means.

M. Molesch, of Prague, recently read a paper before the Academy of Science of Vienna concerning phosphorescent bacteria, upon which he made a number of researches. He obtains a strong light by a collection of these bacteria and can even take photographs with it. When the bacteria are placed in a culture bouillon contained in flasks of one or two liters capacity, they form a "bacteric lamp" which gives a strong enough light to read a thermometer or see the dial of a watch at a distance of one or two yards. The experimenter thinks that such a bacteric lamp, as it gives no perceptible heat, will be of service in powder magazines and in scientific work. It can be also used under water to attract fish, as the flask can be hermetically sealed. When placed in suitable conditions, the bacteria possess the phosphorescent properties for several weeks.

CALLITYPY—A NEW WAY OF USING THE TYPEWRITER.

BY JACOB BACKES.

How the typewriter and photo-engraver can work hand in hand and perform all the work of the printer I have had occasion to set forth in two articles published in the SCIENTIFIC AMERICAN SUPPLEMENT. Briefly described, the method of doing away with typesetting consists in typewriting the matter to be printed, and in making line engravings therefrom which can be used as printing-plates. The possibilities of thus using typewriters were illustrated in the articles mentioned. It is the purpose of the present article to show the more recent improvements that have been made in "callityping," as this new way of using the typewriter is called.

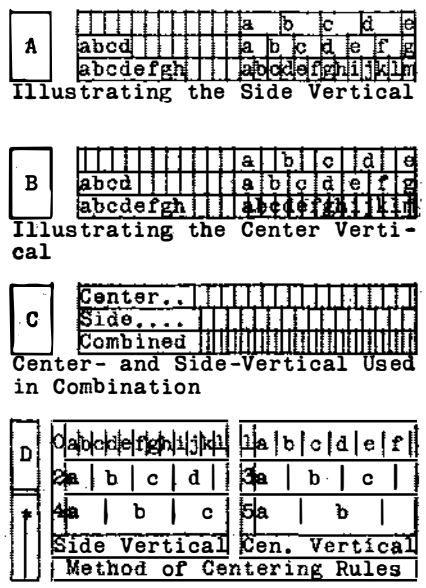

Illustration 1.—Callitype. Reduced From Original in Ordinary Typewriting Size.

In the SCIENTIFIC AMERICAN SUPPLEMENT for April 4 last were published specimens of callitypic composition in different sizes of type, in describing which the direction was given to use pen, ink, and ruler in making vertical lines. But in the practical application of this print-typing method it has since been proved that two different vertical marks, added to the machine's type equipment, and adjusted so as to strike at two certain points, relatively to the position of adjoining or adjacent alphabetic or numeral characters, give greater satisfaction and are more convenient and expeditious to use than lines made with pen and ink.

SEPTEMBER 1903						
Su	Mo	Tu	We	Th	Fr	Sa
—	—	1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	[illegible]		

BROOKLYN					
NAMES	R	1B	PO	A	E
Strang, 3b....	1	1	2	3	0
Sheckard,lf...	0	0	0	0	0
Dobbs, cf.....	0	2	1	0	0
Doyle, 1b.....	0	2	13	1	0
Dahlen, ss....	1	1	3	4	0
McCreery,rf...	1	1	1	0	0
Flood, 2b.....	1	0	2	0	0
Ritter, c.....	0	1	5	0	0
Garvin, p.....	0	0	0	4	0

Illustration 2.—Callitype. Reduced From Original in Ordinary Typewriting Size.

Illustration 1.—*A.* The type for the side vertical is so engraved and positioned that it will strike at the left of the following character, and midway between that character and the one immediately preceding. *B.* The center vertical is centrally engraved and positioned, so as to strike between two characters, one space distant from each other. *C.* This is self-explanatory. *D.* Where letters or columns are an even number of spaces apart, a side vertical liner is used to secure midway position of perpendicular line; and where letters or columns are positioned an odd number of spaces apart, the center vertical is used.

In Illustration 4, *f* stands for *flat;* 1, whole note; 2, half note; 4, quarter note; 8, eighth note. As music notation recognizes no third or sixth notes, the figure 6 could be used as an abbreviation for a sixteenth, and 3 for a thirty-second, note. Symbolic corollaries are: *s* for *sharp*, *n* for *natural*, *r* for *rest*, etc., using small letters to show key, pitch, and time, and capitals for expression.

Side and center-verticals should begin and end on two consecutively typed underscores, and each vertical should be just long enough to type an unbroken vertical column when struck under each other. It is important that the paper feed of the machine be as exact as possible, so that the horizontal rulings made by the underscore can be depended on to be equidistant on all parts of the sheet. To test a machine for this, operators make vertical rows of close-lined parentheses, thus:

```
(((        (((        (((
(((        (((        (((
(((        (((        (((
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at the middle and extreme margins of the sheet. These rows should have a longer perpendicular length than the circumference of the roller. All parts of the sheet should be closely examined for deviation from perpendicular equidistances between the ends of the parentheses.

In ink pad machines squares, rectangles, etc., are made by typing the left vertical from the upper left-hand corner down; then across; then up; then the carriage is shifted to first position, and a horizontal underscore left to right finishes. In making perpendicular lines the thumb of the left hand continuously holds down the space bar; another finger of same hand strikes the vertical-liner key; and right-hand fingers turn the roller by the knob for successive line changes of striking point. For ribbon machines this manipulation secures little or none of the necessary ribbon movement, therefore columnar lines are made downward only, governing the striking points of the vertical liner by proper settings of margin stop and ordinary use of the line-spacing lever.

The illustrations show the possibilities of the vertical liners in type composition. The original typewritings were photographically reduced to different sizes of characters, and any effect in any size can, of course, be as easily obtained in any other size. Ambitious tabulators, music composers, and draftsmen who use or have access to the writing machine should note that there is room for still further development and improvement.

What to printers is known as bordered, panele and rule-and-figure work — classes of expensive and exacting type-composition either outside the range or only conditionally within range in the operation of type-setting or line-casting machines — becomes, through the callitpyic operation of the writing machine, as facile and economical as ordinary composition.

The comparatively difficult and expensive kind of type-composition known as intersecting-rule and rule-and-figure work, which has always been a stumbling block to line-casting and type-setting machines, seems to be the destined particular field of callitypy, as in it such typing proceeds almost as rapidly as "straight" matter, could easily be done by the proficient operators of all writing machines, and type-high, ready-for-press callitypes (blocks) could be made from typewritten copy at 5 cents per square inch, in any size of type. In book and news work, nonpareil is the most favored size for the class of composition referred to, and it now costs 14 cents per square inch.

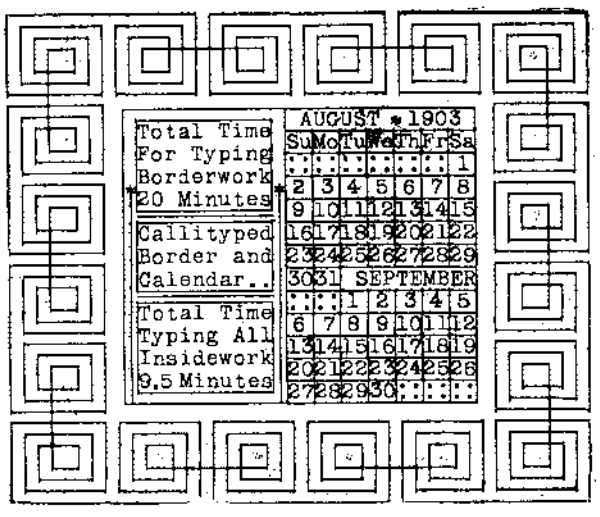

Illustration 3.—Callitype. Reduced From Original in Ordinary Typewriting Size.

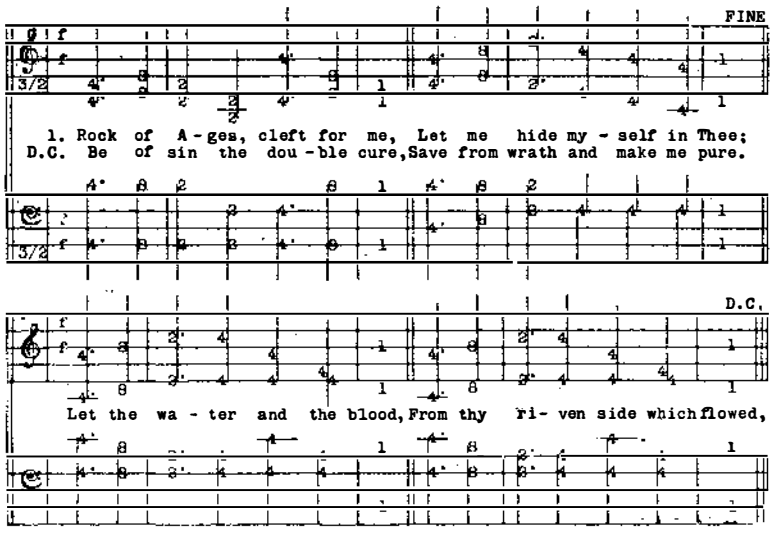

Illustration 4.—Callitype Reduced From Original in Ordinary Typewriting Size.