equal proportions from either sex. I exhibited copies of fifty-four of them (made by a camera lucida) at the Anthropological Institute on Tuesday, March 9, when I read a paper on the subject. The meeting was attended by several of my correspondents, who are well known in the scientific world, and who explained to the meeting their respective forms. They were Mr. George Bidder, Q.C., the Rev. G. Henslow, Mr. Roget, Mr. Schuster, F.R.S., Mr. B. Woodd Smith, and Col. Yule, C.B. Two of these, namely, Mr. Henslow and Mr. Schuster, see the forms objectively; they can point to the direction in which at any moment any particular figure appears to them to lie, and when they move their eyes the form moves too. In the other four cases the close co-ordination between brain and eye does not exist, and their images appear in a sort of dreamland having no strict relation with external space. The form of each observer is quite unserviceable to the rest, having no meaning except to himself.

The language employed by persons in respect to some of the features of these forms is apt to be very similar. Phrases are frequently met with, such as "Ever since childhood I have always seen . . . " "I cannot account for their origin in any way;" "It is perfectly independent of the will." I have verbally questioned a great many acquaintances whether they see numerals in any particular way. They usually say No; they ask what I mean, then profess inability to understand my object, and evidently think it some nonsensical fancy. But I get my reward in the proportion of cases I have mentioned. I have already become familiar with the quick look of intelligence on these occasions, and with the reply in words denoting that the right chord had been struck. Then the details are poured forth. I am frequently told how the habit used to be mentioned to relatives, but was ridiculed, and had ceased to be spoken about; or again, how some particular brother or sister had the same habit, but that one only, and so forth. The more I follow up the inquiries, the more the accuracy of the first replies becomes evident; thus, I ask for fresh sketches, and they correspond to the first. The general result is, that these statements bear all the marks one could expect of being the reports of what is clearly seen and what the writer is anxious to describe exactly. Among my foreign correspondents whose names are well known to the scientific world, and whom I am permitted to quote, are M. Antoine d'Abbadie, the traveller, and Member of the Institute, and Baron von Osten Sacken, the Russian entomologist.

Now for the results. These forms (as distinguished from the figures now seen upon them) are survivals of a very early mental stage, and must have originated before the child learnt his letters. There is no nursery book or diagram that could suggest their fantastic shapes. Their very variety shows them to be derived from no common origin. They frequently turn with a left-handed twist, which written and printed things do not. They are more archaic than the alphabetical and historical forms used by the same persons, for these bear evident marks of their origin. The clock face has little or nothing to do with them, for its influence can only be traced in three cases. I believe the forms to have been mnemonic diagrams, invented by the children when they were learning to count *verbally*, the *sounds* of the successive numerals being associated with the successive points of the form. Also, that when the children began to read, the visual symbols of the numerals quickly supplanted the verbal ones, and established themselves permanently in their place. On this supposition we possess in these numerical forms a representation of the route along which the attention naturally travels in the mental field of view of the child. It is entirely the child's own way of working, and therefore true to his nature; and being natural, it persists through life and offers itself in the adult for our examination.

The characteristic run of the lines in each form has some general similarity to that of the correspondent's hand-writing, but it must testify more directly to his mental peculiarities than the latter. The form shows the ways that the mind most likes to travel by, but the hand-writing is a compromise between what the writer desires to produce under the joint guidance of a natural fancy, of education and of fashion, with what the muscles of the hand can most easily effect. These forms or natural lines of thought are, I presume, analogous to those that instinctively prompt each species of animal to make his lair, burrow, nest, or other piece of domestic architecture, on an identical plan, with trifling individual variations, and that prompts gregarious animals to group themselves always in the same sort of array. In these numerical forms we find real "psychograms."

One of the most obvious facts common to them is the curious proof they afford of the perplexity caused by our barbarous nomenclature of the numerals. We *say* "ten," "eleven," "fifteen," &c., when we *see* "one-nought," "one-one," "one-five," &c., and other civilised nations are as bad or worse than ourselves, as the French with their "soixante quinze." The way in which the perplexity is shown is by the wriggles and twists in the forms at 10 and 12 and by the exceptional length of the 'teens. It is not easy to describe in a few words what is so variously pourtrayed, but the general effect on looking at my collection is most striking. It is really painful to think of the vast amount of petty difficulty to the existence of which this indisputable testimony is given. The difficulty does not cease with childhood, else the twists would have been smoothed away, and I am sure from trials on myself that I for my part still feel it much. I can dictate more easily by saying on-one, on-two, &c., and I can write and sum from dictation much more quickly when some such plan is used. It should be adopted by those who want to remove as much friction as possible from their brain-work. I have little doubt that the conflict between our language and our notation is a serious though unsuspected hindrance to the ready establishment of decimal weights and measures.

I find from inquiries made for me at schools that young people see forms more commonly than adults, but that their forms are less developed and sure. I conclude that where they are vivid and serviceable they are much used, and insensibly grow in vividness, in definition, and in automatic character. Otherwise they decay from disuse and become forgotten. Hence arises the rather sharp division between the seers and non-seers in adult life.

I am still desirous of more information on this subject, especially concerning children, and on colour associations with figures, letters, and words.

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THE TELEPHONIC EXCHANGE IN THE UNITED STATES

THE telephone has already become firmly established in America as a medium of daily communication. Eighty-five towns are thus connected, and to the various telephonic companies there are 70,000 subscribers, and the number is rapidly increasing. For some details as to the working of this method of intercommunication we are indebted to our French contemporary *La Nature*. If we enter the great hall of the central office of the Merchants' Telephone Exchange at 198, Broadway, New York (Fig. 1), we see a series of "Switchmen" engaged in establishing communications among the subscribers. There is a switchman corresponding with one of the subscribers who has called (Fig. 2); further on is another *employe* engaged in raising the notice signal. In the city, in the subscriber's house or office, is the office telephone, which is set up in a great number of houses; this model is very convenient for business, for it permits of speaking into the mouth-piece placed on the left, of

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listening with the telephone, which is unhooked to apply to the ear, and at the same time of taking notes on the desk with the free hand.

The Broadway system of telephones belongs to the class of Pile Telephones, which allows these piles to be used to call the attention of the subscribers by means of ordinary bells, like the one in the desk, Fig. 4

The transmitter is Edison s carbon telephone, based on the variations in electric resistance produced by variations of pressure which the plate exercises when we speak in front of the mouthpiece. The circuit is formed by the pile, two Leclanche elements, the transmitter, and a small Ruhmkorff coil. It constitutes the primary circuit of the coil. The line and the receiver of the other post are connected by the secondary wire of the bobbin, a wire whose other extremity is connected with the receiver of the post and with the earth. It follows that the line-currents are currents induced by the variations of activity of the current which traverses the primary wire of the coil. This arrangement has the effect of transforming into currents of tension the undulatory currents of the transmitter, of rendering them less sensible to the variations of resistance of the line, of facilitating the adjustment and suppressing a part of the commutators, the management of which might cause mistakes.

The receiver is a Phelps telephone, analogous to the Bell telephone, but the magnet of which is turned round in the form of a ring, which renders its management very easy (Fig. 4). In the position of repose or waiting, the telephone hangs on its hook, and by this fact alone, it comes into contact with a part forming a commutator, which suppresses all the telephonic part of the circuit, in order that the bell alone may intervene. Everyrhing is thus ready for a call.

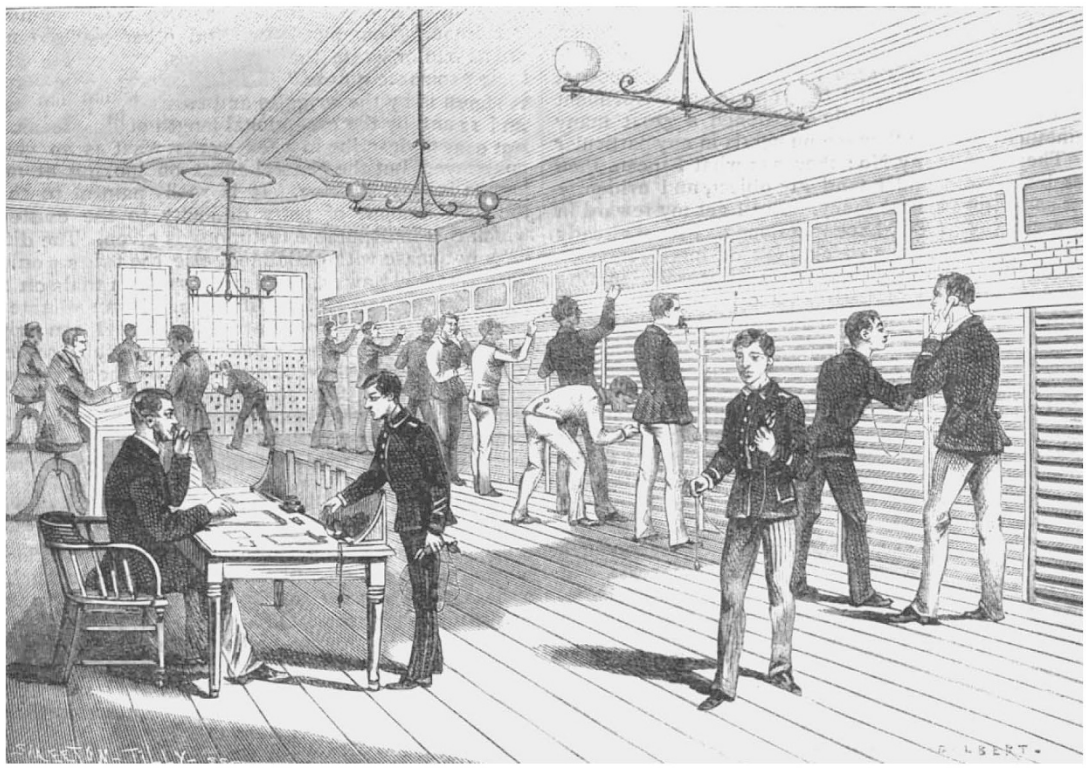

FIG. 1.—Interior view of the administration of the Merchants' Telephone Exchange, New York.

The telephones of the central post, speaker and receiver, are analogous to those of the subscribers; but to facilitate the management of these apparatus the speaker and receiver are mounted on the same steel stem, somewhat bent to serve as a handle, as in Fig. 2, and forms at the same time the magnet of the receiver. We may now follow all the series of operations. Suppose subscriber No. 731, whom we will call Edward, wishes to correspond with 511, whom we will call John. Edward begins by pressing on a small knob on the right side of the desk, Fig. 4. As the telephone is suspended it follows that in that position the current of Edward's pile traverses the line and a small electro-magnet in the central office; the electro-magnet, becoming active, detaches a small door (Fig. 2), which falls with a noise sufficient to call the attention of the *employe*, and exposes the number 731. The *employe* then places himself in communication with Edward, by placing the wire which corresponds to his telephone on a longitudinal copper bar also connected with Edward's line. The conversation then begins with the useful shout of hallo! hallo! Edward asks the *employe* to place him in communication with No. 511. If No. 511 is free at the moment the *employé* presses a knob after having connected the wire of No. 511 with the knob. The bell of John is set agoing, and when he himself is ready to correspond he presses the knob of his bell, which causes the door of his number to fall. By then placing a wire of communication directly between the two horizontal bars which correspond to the wires of Edward and John, direct communication between these two correspondents is established. If at this moment the *employe* is obliged to withdraw his telephone the communication between Edward and John is secret. If while these two are in conversation No. 42, James, wishes to correspond with John, for example, the *employé* may join in the conversation of the two interlocutors just like a servant announcing a visitor. If required, conversation may be established between the three subscribers. When

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the conversation between Edward and John is ended, they each hang up their telephones and press upon the

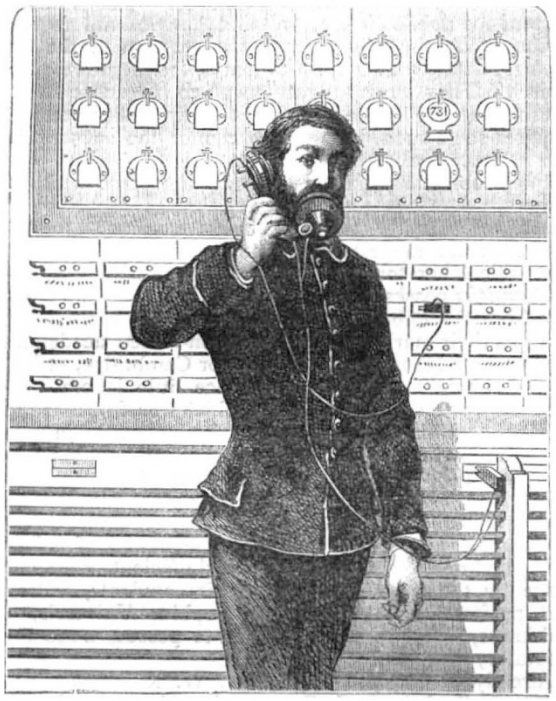

FIG. 2.—Switchman corresponding with a subscriber

knobs, when the number of each is again exposed at the central post. The *employé* then knows that the conversation between the two subscribers is ended; he raises

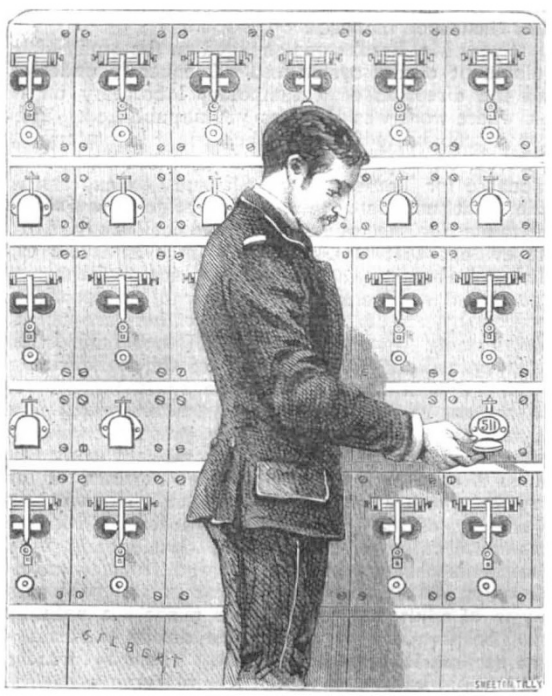

FIG. 3.—Another *employe* raising the warning signal.

the door, suppresses communication between Edward and John, and all is ready for a new call.

In posts where there are 500 or 600 subscribers the numbers are arranged in order on tables containing each 500 to 100 doors; special arrangements are then employed to bring the series into communication with each other. At New York the central office makes not less than 6,000 communications daily, and everything is conducted to the complete satisfaction of the subscribers. The telephone has become for them as indispensable as the omnibus or hansom for London. Every month a list of subscribers is distributed from the central office. The Chicago list already forms a small volume. The Ameri-

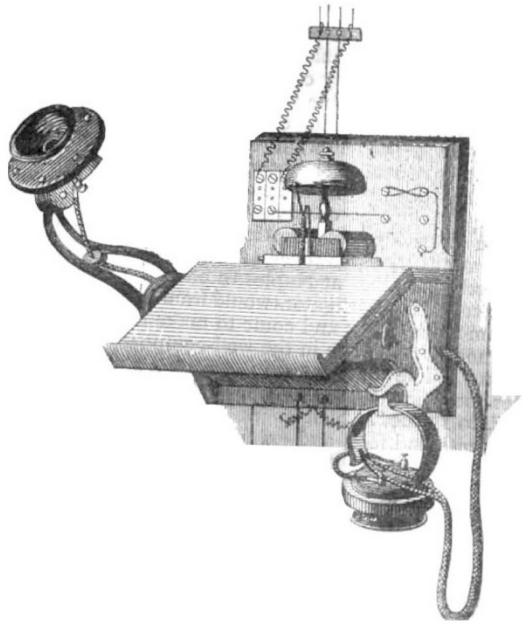

FIG. 4.—Telephone fitted up in a subscriber's office at New York.

can District Telegraph Company has greatly extended its services, and informs its subscribers that in three minutes after they call a liveried servant will be at their doors to distribute notes, circulars, &c., carry parcels, accompany a lady or a child to any place desired, or go for them, carry umbrellas to the children at school on a wet day, fetch the doctor, a cab, &c., &c., at any hour. We believe a beginning has been made in London of this invaluable means of communication; we trust that some arrangement will be come to with the Post Office authorities that will permit of its becoming universal. Its advantages are patent.

AN AMERICAN SEA-SIDE LABORATORY

THERE are some persons who, in their enthusiasm for doing a good thing, are led to mistake the name for the deed and to make as much fuss and general congratulation over an utterly inadequate representation of the good thing aimed at as would only be justified by the accomplishment of the good thing itself. One would have no special remark to offer on such curious self-deception, were it not that very frequently harm is done in connection with it in consequence of the enthusiastic individuals deceiving not only themselves but the public. Thus a worthy object is liable to be shelved or put aside from public attention on the ground that it has been accomplished, when really there has been only the most ridiculous pretence (consisting in the use of empty words), of attaining a long-desired and important end. Not only this, but such shams having once passed currently for the real things, the name of which has been

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