moment the keeper departs, they flock to their posts of observation with provoking assurance. It is found that the keepers must go to the cover in parties of six or more, then depart one by one until six have left, leaving one or more behind to take vengeance on the crows. Should a less number than six visit the shelter, and all but one leave it, the crows perform the subtraction correctly, and know that there is yet no safety for them. Beyond six, their mathematical faculty fails—or did some years ago: perhaps they have learned to count more by this time.

It seems that the crows of Maine are only half as highly educated. A farmer in that State, exasperated by the depredation of crows among his sprouting corn, lay in wait for them often and long, but without success. Then he tried the German stratagem. He took his son with him to a shanty in the field, and shortly after sent him away; the hungry birds patiently waited until the farmer also departed, then they helped themselves. The next day he took two persons with him with the same result; first one person left the field, then another, the crows cawing their approval, but remaining in their safe position; and not until the third person had been seen to depart from the field would the cunning creatures trust themselves within gunshot of the little building. The next day, half a dozen entered it. Presently one of them went back across the field. The crows mentioned the fact among themselves, but kept their distance, among the trees. Another person went away, with the same result. Directly a third emerged from the building and disappeared, the unhappy crows, having reached the end of their mathematical rope, came down in platoons to their deferred breakfast, unaware of the three armed enemies still remaining in the building, who at once opened fire upon the poor birds, whose great misfortune was that they were unable to count more than three.

A gentleman writing to the Portland *Advertiser* says that this experiment was tried repeatedly, but the crows invariably lost their reckoning when the number exceeded three.

Evidently the education of the crows of Maine has been neglected. It would be an interesting experiment to repeat the process of deception to see how long it would take them to count four, or more.

THE CENTENNIAL BILL PASSED.

The bill appropriating $1,500,000 for the purposes of the Centennial Exposition has become a law. It passed the Senate by a vote of 40 to 15, and was soon after signed by the President with the plume of an American eagle, which some patriotic individual provided for the occasion. The accession to the Centennial funds prevents, it is said, the accumulation of any debts for the completion of the buildings and grounds. The act which grants the money is coupled with a stipulation that the sum shall be repaid into the United States Treasury, without interest, out of any profits which may remain after the subscribers to the capital stock shall have been reimbursed. This is of course a contingency which may or may not happen; but in any event the stipulation is a favorable one, and will tend greatly to appease the large number of people who have been opposed to Congress extending any pecuniary aid to the enterprise.

The financial prosperity of the Exposition now being secured, it remains for exhibitors to lend their best endeavors to assist the Centennial commission in having the entire American part of the show in readiness by the opening day. Our correspondents at Philadelphia state that goods are arriving very slowly, and that present indications point to a grand rush during the month of April. This only entails extra labor upon the Exposition officials, and tends to produce troublesome confusion and dissatisfaction among the exhibitors. It is very much to be hoped that exhibitors will not follow their usual practice, at the annual fairs throughout the country, of thus waiting until the last minute before sending their entries. They will find early arrival on the field to be very much to their own and to the general advantage.

THE COLLAPSE OF THE SHEFFIELD AMERICAN STEEL RAIL TRADE.

In referring to the progress of the steel rail manufacture in this country, nearly a year ago, we took occasion to point out the rapid falling off in the importation of steel rails from England, and expressed the opinion that a still further decrease would follow. We have, moreover, long adhered to the belief that, with our vast stores of mineral wealth supplying the material, all that our people have needed is experience and knowledge in utilizing it; and as that experience and knowledge augmented, so would our reliance upon the labor of other countries decline. As matters stand now, to quote from the English *Ironmonger*, "in the management of the Bessemer plant, the Americans must be yielded the palm; and this palm was yielded even by the English steel masters themselves at their great Barrow meeting. The real truth is that the Americans have learned how to make steel rails as well, if not better, than Englishmen, and there is no good to be obtained by hiding the fact."

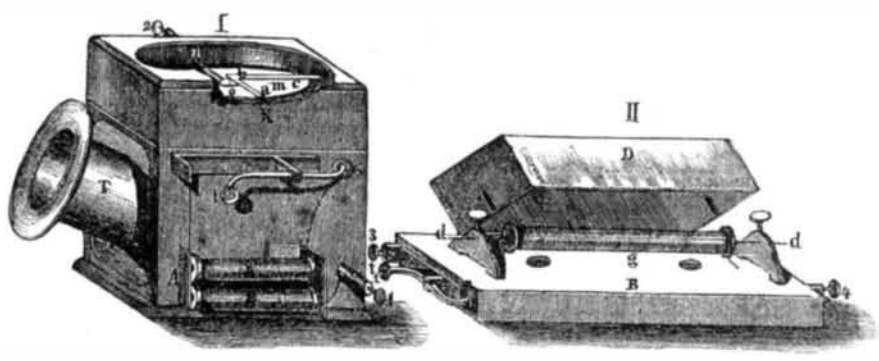
The reason of this candid admission by a leading English metal trade organ is found in the recent report of Dr. Webster, the American Consul at Sheffield. Steel makers in that great manufacturing town had felt severely the effects of a falling off in their American sales; but none, it appears, were prepared for the alarming announcement that the American market for their rails had practically closed against them. In 1873, Sheffield exported steel goods of all kinds to the United States of an aggregated value of $8,298,865; in 1874, this had fallen to $6,315,240; and the declared value of goods exported in 1875 still further falls to $3,456,160: a reduction of $5,000,000 in two years. Out of this aggregate of $3,456,160 for 1875, the value of the rails imported is but $11,505, and those rails were brought over here during the quarter ending March 31, 1875. Since that date, not a single tun of Sheffield rails has entered the country. For the last nine months of 1873 and 1874 respectively, the value of the rails imported hither was $1,311,890 and $1,136,610.

There are just four reasons for this loss of trade, which has stopped the machinery in several large Sheffield establishments. Two, namely, our high tariff and financial stress, might be urged with equal force as regards any other dutiable class of exports, and these, therefore, affect not a single branch of the latter, but our entire commerce with any foreign nation. The other two must be admitted as the more immediate causes; and these are, first, our progress, as already noted; and second, the blind conservatism, to use a mild term, of the Sheffield working men. So long as these men, through their combinations, persist in doing almost exactly as their grandfathers and fathers did to accomplish specific manufacturing results, so will they be distanced by more progressive people, irrespective of the nation to which the latter belong. Manufacturers, who employ a class of men who, again to quote an English contemporary, "display inveterate opposition to the use of modern mechanical appliances," must expect to find their productions unsought and their capital wasted; nor can they hope to compete with their American brethren, in whose more prosperous establishments the introduction of new machinery one year, and its abandonment for still further improved appliances before the twelve month has passed, are common occurrences.

THE INVENTION OF THE TELEPHONE.

BY P. H. VANDER WEYDE, M. D.

In connection with Mr. Gray's application of the telephone to the simultaneous transmission of several different telegraphic messages over one wire at the same time, and his paper read before the American Electrical Society (published on page 92, SCIENTIFIC AMERICAN SUPPLEMENT for February 5), it may be interesting for the readers of this paper to obtain some information in regard to the invention of the telephone, by Reuss. As mentioned in the article above referred to, Page and Henry observed that, by rapid magnetization and demagnetization, iron could be put into vibrations isochronic with the interruptions of the current; and later, Marian experimented extensively in this direction, while Wertheim made a thorough investigation of the subject, which induced Reuss, of Friedrichsdorf, near Homburg, Germany, to apply this principle to the transmission of musical tones and melodies by telegraph; and he contrived an apparatus which we represent in the engravings.



PROFESSOR REUSS' TELEPHONE.

The telephone of Reuss consists of two parts, the transmitting and the receiving instrument. Fig. I represents the former, and is placed at the locality where the music is produced; Fig. II, the latter, is placed at the station where the music is to be heard, which may be at a distance of 100, 200, or more miles, in fact, as far as the battery used can carry the current: while the two instruments are connected with the battery and the telegraph wire in the usual manner. One pole of the battery is connected with the ground plate, the other with the screw, marked 2 in our Fig. I, and thence over a thin copper strip, *n*, with the platinum disk, *o*, attached to the center of the membrane stretched in the large top opening of the hollow and empty box, K, intended to receive and strengthen the vibrations of the air, produced by singing before the funnel-shaped short tube attached to the opening in T. Over the platinum disk, *c*, attached to the elastic membrane, is a platinum point attached to the arms, *b c* and *b* K, while a set screw brings this point in slight contact with the platinum disk mentioned. A part of the box is represented as broken and removed, in order to show the internal construction. The strip, *a b c*, is connected with the end, *s*, of the switch, *t s*, and the screw connection, 1, at the lower right hand corner, and also, through the telegraph wire, to the instrument, Fig. II, at the receiving station, which may be situated at the distance of many miles. Here the current enters by the screw connection, 3, and passes through the spiral, *g*, surrounding the soft iron wire, *d d*, of the thickness of a knitting needle, and leaves the apparatus at the screw connection, 4, whence it obtains access to the ground plate, and so passes, through the earth, back to the battery. The spiral and iron wire, *d d*, is supported on a hollow box, B, of thin board; while a cover, D, of the same material is placed on top, all intended to strengthen the sound produced by the vibrations which the interruption of the current caused in the iron wire, *d d*, so as to make these vibrations more audible by giving a large vibratory surface, in the same way that the sounding board of a pianoforte strengthens the vibrations of the air caused by the strings, and makes a very weak sound quite powerful.

If a flute be played before the opening, T, or if a voice be singing there, the vibration of the air inside the box, K, causes the membrane, *m*, to vibrate synchronically, and this causes the platinum disk, *o*, to move up and down with corresponding frequency. At every downward motion the contact of this disk with the platinum point, under *b*, is broken; and therefore the current is interrupted as rapidly as the vibrations occur. Let, for instance, the note C be sounded; this note makes 64 full vibrations in a second, and we have, therefore, 64 interruptions of the electric current, which interruption will at once be transmitted through the telegraph line to the receiving instrument, and put the bar, *d d*, into exactly similar vibrations, making the very same tone, C, audible; and so on for all other rates of vibration. It is clear that, in this way, not only the rhythm of music can be transmitted (and this can be done by the ordinary telegraph), but the very tones, as well as the relative durations and the rests between them, can thus be sent, making a full and complete melody. The switch, *t s*, Fig. I, is intended, in connection with a similar one in Fig. II, to communicate between the stations, with the help of the electro-magnet, E E, to ascertain if station, Fig. II, is ready to receive the melodies; then it gives the signal, by manipulating the switch, which is received by the attraction of the armature, A, the latter arrangement being a simple Morse apparatus, attached to the telephone.

Professor Heisler, in his "*Lehrbuch der technischen Physik*" (3d edition, Vienna, 1866), says, in regard to this instrument: "The telephone is still in its infancy; however, by the use of batteries of proper strength, it already transmits not only single musical tones, but even the most intricate melodies, sung at one end of the line, to the other, situated at a great distance, and makes them perceptible there with all the desirable distinctness." After reading this account in 1868, I had two such telephones constructed, and exhibited them at the meeting of the Polytechnic Club of the American Institute. The original sounds were produced at the further extremity of the large building (the Cooper Institute), totally out of hearing of the Association, and the receiving instrument, standing on the table in the lecture room, produced (with a peculiar and rather nasal twang) the different tunes sung into the box, K, at the other end of the line; not powerfully it is true, but very distinctly and correctly. In the succeeding summer I improved the form of the box, K, so as to produce a more powerful vibration of the membrane, by means of reflections effected by curving the sides; I also improved the receiving instrument by introducing several iron wires in the coil, so as to produce a stronger vibration. I submitted these, with some other improvements, to the meeting of the American Association for the Advancement of Science, and on that occasion (now seven years ago) expressed the opinion that the instrument contained the germ of a new method of working the electric telegraph, and would undoubtedly lead to further improvements in this branch of Science, needing only that a competent person give it his undivided attention, so as to develope out of it, all that it is evidently capable of producing.

Before leaving this subject, I wish to draw special attention to the fact that the merits of this invention consist chiefly in the absence of musical instruments, tuning forks, or their equivalents, for producing the tones: any instrument will do, flute, violin, human voice, etc. If the aerial vibrations are only conducted into the box, Fig. I, the apparatus will send the pitch as well as the duration of the different tones, with the rests between, therefore not only transmitting perfect rhythm, but a complete melody, with its long and short notes. The two parts of the apparatus may even be connected each to a separate pianoforte; and if this were done in a proper manner, a melody played on the pianoforte connected with the transmitting instrument, Fig. I, would be heard in the pianoforte, at a great distance, connected with the receiving instrument, Fig. II.

Fighting Rams.

Says a correspondent of the Ohio Farmer: "At certain seasons of the year, rams are apt to develop their combative propensities, and those who keep several of them together often have trouble on account of their injuring each other. It is well known that they always 'back-up' to get a start to butt. Stop their backing-up and you disconcert them entirely. To do this, take a light stick (a piece of broom handle will do), about 2 or 2½ feet long. Sharpen one end and lash the other end securely to his tail: the sharpened end will then draw harmlessly on the ground behind as long as his majesty goes straight ahead about his business; but on the attempt to 'back-up' he is astonished to find an effectual brake in the rear. Don't laugh and call this 'all gammon:' but if you have a butting ram, try it, and the time to laugh will be when you see him jump out sideways, and whirl round and round, trying to inspect the machine, which will keep behind him."

DR. HAUGHTON has proved that the strength of the lion is only two thirds that of the tiger.