descent gases that have emanated in enormous quantities from the interior, will remain for some time.

The observations of the spectrum show beyond doubt that the decrease in the light of the star is in connection with the cooling of its surface. The violet and blue parts decreased more rapidly in intensity than the other parts, and the absorption bands, which crossed the spectrum, have gradually become darker and broader.

Finally Herr Vogel regrets that the news of the discovery of the new star by Herr Schmidt was only known so late, as doubtless during the first few days most interesting changes must have occurred in the spectrum, while the star rapidly decreased in brightness. Herr Vogel recommends that in case of appearance of other new stars no time should be lost before spectral observations are made, and points out that even with small telescopes very useful results may be obtained, if care is taken that spectroscopes are used of sufficiently low power of dispersion.

The position of the new star with regard to two neighbouring stars of magnitudes 9·1 and 9·4 Herr Vogel has determined as follows :—

Nova − * 9m·1 (*Bonn. Durchmust*, + 42°, 4184)
1877·0 $\Delta\alpha$ = − 25s·00 $\Delta\delta$ = + 1′ 15″·4
Nova − * 9m·4 (*Bonn. Durchmust.*, + 42°, 4185)
1877·0 $\Delta\alpha$ = − 35s·34 $\Delta\delta$ = − 1′ 13″·2.

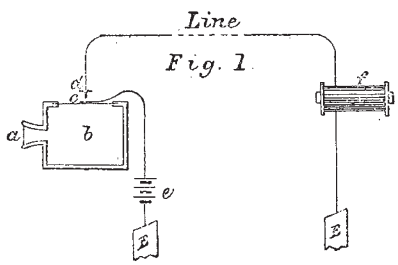
As the first of the comparison stars has been determined at the meridian circle of Bonn, the position of the new star is :—

1877·0, 21h. 36m. 52s·48 + 42° 16′ 54″·5.

THE TELEPHONE [1]

IN the following paper I call instruments employed in the transmission of musical sounds, tone telephones, and those employed in the transmission of the human voice, articulating telephones.

In the year 1837, Page, an American physicist, discovered that the rapid magnetisation and demagnetisation of iron bars produced what he called "galvanic music." Musical notes depend upon the number of vibrations imparted to the air per second. If these exceed sixteen we obtain distinct notes. Hence, if the currents passing through an electro-magnet be made and broken more than sixteen times per second, we obtain "galvanic music" by the vibrations which the iron bar imparts to the air. The iron



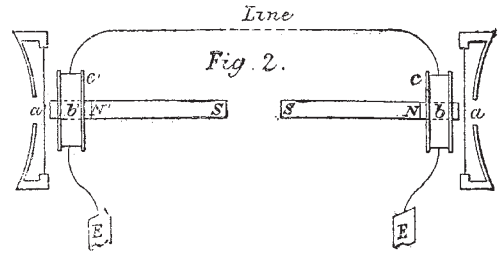
bar itself mparts these vibrations by its change of form each time it is magnetised or demagnetised.

De la Rive, of Geneva, in 1843, increased these musical effects by operating on long stretched wires which passed through open bobbins of insulated wire.

Philip Reiss, of Friedrichsdorf, in 1861, produced the first telephone which reproduced musical sounds at a distance. He utilised the discovery of Page by causing a vibrating diaphragm to rapidly make and break a galvanic circuit. The principle of his apparatus is shown Fig. 1.

b is a hollow wooden box into which the operator sings through the mouthpiece *a*. The sound of his voice throws the diaphragm *c* into rapid vibration so as to make and break contact at the platinum points *d* at each vibration. This interrupts the current flowing from the batteries *e* as often as the diaphragm vibrates, and therefore magnetises and demagnetises the electro-magnet as often. Hence whatever note be sounded into the box *a* the diaphragm *c* will vibrate to that note, and the electro-magnet *f* will similarly respond and therefore repeat that note.

Musical sounds vary in tone, in intensity, and in quality. The tone depends on the number of vibrations per second only; the intensity on the amplitude or extent of those vibrations; the



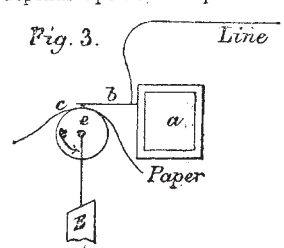
quality on the form of the waves made by the vibrating particles of air.

It is evident that in Reiss's telephone everything at the receiving end remains the same, excepting the number of vibrations, and therefore the sounds emitted by it varied only in tone and were therefore notes and nothing more. The instrument remained a pretty philosophical toy and was of no practical value.

Cromwell Varley, in 1870, showed how sounds could be produced by rapidly charging and discharging a condenser.

After alluding to the invention of Mr. Elisha Gray (NATURE, vol xiv. p. 30), Mr. Preece said :—

It remained for Prof. Graham Bell, of Boston, who has been working at this question with the true spirit of a philosopher since 1872, to make the discovery by which tone, intensity, and quality of sounds can all be sent. He has rendered it possible to reproduce the human voice with all its modulations at distant points. I have spoken with a person at various distances up to thirty-two miles; and through about a quarter of a mile I have heard Prof. Bell breathe, laugh, sneeze, cough, and in fact make any sound the human voice can produce. Without explaining the various stages through which his apparatus has passed, it will be sufficient to explain it in its present form. Like Reiss he throws a diaphragm into vibration, but Prof. Bell's diaphragm is a disc of thin iron *a*, which vibrates in front of a soft iron core *b*, attached to the pole of a permanent bar magnet N S (Fig. 2). This core becomes magnetised by the influence of the bar magnet N S, inducing all around it a magnetic field, and attracting the iron diaphragm towards it. Around this core is wound a small coil *c* of No. 38 silk-covered copper wire. One end of this wire is attached to the line wire, the other is connected to the earth. The apparatus at each end is identically similar, so that it becomes alternately transmitter and receiver, first being put to the mouth to receive sounds, and then to the ear to impart them. Now the operation of this apparatus depends upon the simple fact that any motion of the diaphragm *a* alters the condition of the magnet field surrounding the core *b*, and any alteration of the magnet field, that is either its strengthening or weakening, means the induction of a current of electricity in the coil *c*. Moreover, the strength of this induced current depends upon the amplitude of the vibration,



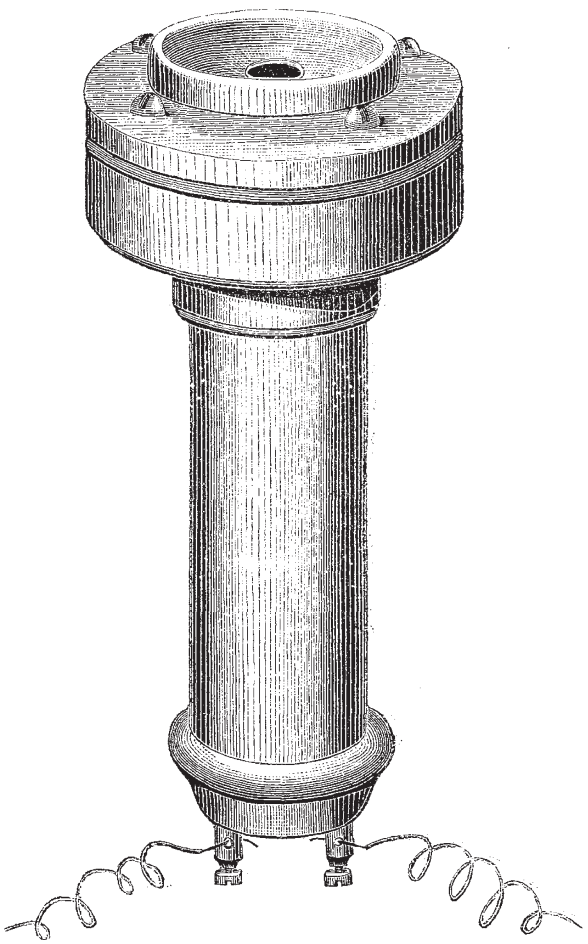
and its form or the rate of vibration. The number of currents sent of course depends upon the number of vibrations of the diaphragm. Now each current induced in the coil *c* passes through the line wire to the coil c^1, and then it alters the magnetisation of the core b^1, increasing or diminishing its attraction for the iron diaphragm a^1. Hence the diaphragm a^1 is vibrated also, and every vibration of the diaphragm *a* must be

[1] Paper read by Mr. W. H. Preece, Memb. Inst. C.E., at the Plymouth Meeting of the British Association. For the sectional cuts we are indebted to *Engineering*.

repeated on the diaphragm *a* with a strength and form that must vary exactly together. Hence, whatever sound produces the vibration of *a* is repeated by a^1, because its vibrations are an exact repetition of those of *a*.

It is quite evident, however, that Bell's telephone is limited in its range. The currents operating it are very weak, and it is so sensitive to currents that when attached to a wire which passes in the neighbourhood of other wires, it is subject to be acted upon by every current that passes through any one of those wires. Hence, on a busy line, it emits sounds that are very like the pattering of hail against a window, and which are so loud as to overpower the effects of the human voice.

Now Mr. T. A. Edison, of New York, has endeavoured to remedy these defects in Bell's by introducing a transmitter which is operated by battery currents, whose strength is made to vary directly with the quality and intensity of the human voice. In



Bell's Articulating Telephone.[1]

carrying out his investigations in this field he has discovered the curious fact that the resistance of plumbago varies in some ratio inversely with the pressure brought to bear upon it. Starting from Reiss's transmitter he simply substitutes for the platinum point (*d*) a small cylinder of plumbago, and he finds that the resistance of this cylinder varies sufficiently with the pressure of the vibration of the diaphragm to cause the currents transmitted by it to vary in form and strength to reproduce all the varieties of the human voice. His receiver also is novel and peculiar. In 1874 he discovered that the friction between a platinum point and moist chemically-prepared paper varied every time a current was passed between the two, so that the rate with which the paper moved was altered at will. Now by attaching to a resonator *a* a spring *b*, whose platinum face *c* rested on the chemically prepared paper *d*, whenever the drum *e* was rotated and currents sent through the paper, the friction between *c* and *a* is so modified that vibrations are produced in the resonator *e*, and these vibrations are an exact reproduction of those given out by the transmitter at the other station.

Edison's telephone, though not in practical use in America, is under trial. In some experiments made with it songs and words were distinctly heard through 12,000 ohms, equal to a distance of 1,000 miles of wire.

Bell's telephone is, however, in practical use in Boston, Providence, and New York. There are several private lines that use it in Boston, and several more are under construction. I tried two of them, and though we succeeded in conversing, the result was not so satisfactory as experiment led one to anticipate. The interferences of working wires will seriously retard the employment of this apparatus, but there is no doubt that scientific inquiry and patient skill will rapidly eliminate all practical defects.

To Prof. Graham Bell must be accorded the full credit of being the first to transmit the human voice to distances beyond the reach of the ear and the eye by means of electric currents.

[1] This instrument was used by Mr. Preece in his experiments (see NATURE, August 23, p. 342).

THE BRITISH ASSOCIATION

REPORTS.

Report of the Committee, consisting of the Rev. H. F. Barnes, C. Spence Bate, Esq., H. E. Dresser, Esq. (Secretary), Dr. A. Günther, J. E. Harting, Esq., J. Gwyn Jeffreys, Esq., Prof. Newton, and the Rev. Canon Tristram, appointed for the purpose of inquiring into the possibility of establishing a Close Time for the Protection of Indigenous Animals.—Your Committee begs leave to report that the object for which it was appointed continues to receive a considerable share of public attention, and that during the past year the three Acts of Parliament establishing a close time for certain kinds of birds have attracted so much notice that there is no fear of their falling into neglect.

There is no symptom of the diminution of the interest which the Sea-birds Preservation Act (1869) has always excited; and within the past twelve months application for the extension of the close time has been made, according to the provisions of that Act, by the Justices in Quarter-Sessions of Northumberland, Lancashire, and the North Riding of Yorkshire—facts which sufficiently speak for the general appreciation of the measure.

The Wild Birds Protection Act (1872) is possibly viewed by the public with greater favour than either of the others; but your Committee sees little reason to modify the opinion of it expressed in former reports. Nevertheless a conviction under it, presenting some rather important features, in May last, indicates that it is not so entirely useless as had been thought.

The Wild Fowl Preservation Act (1876) came into operation this year, and at first undoubtedly caused some discontent in many quarters, a warm discussion of its principle and provisions being raised by a portion of the public press. Your Committee, however, has noticed with much satisfaction that virtually no objection was taken to its principle, while the necessity of some enactment of the kind was conceded on almost every side. Furthermore, very nearly the sole cause of complaint lay in regard to the limits of the close time therein imposed, on which point no blame attaches to your Committee. The limits of the close time proposed in the Bill, as draughted by your Committtee, and introduced into Parliament, were, as stated in last year's report, altered in its passage through the House of Commons; the change being such as your Committee then declared did not meet with its approval. Your Committee is therefore in no way responsible for the unseasonableness of the close time which was enacted, and believes that the soundness of its views on the subject is now generally admitted. In confirmation of this belief it may be stated that the Justices in Quarter-Sessions of the counties of Dorset, Norfolk, Kent, Somerset, Southampton, Wigtown, and Essex, have severally made application to the Home Office for such an alteration of the close time as will bring it more or less nearly in accordance with that originally proposed by your Committee.

Another charge was brought against this Act. It was alleged to be imperfect in that it did not expressly prohibit the possession or sale, during the close time, of birds of the kinds professedly protected, which had been imported into this country from abroad. This charge was supported by the dismissal (on the latter ground) by two magistrates of informations laid against certain poultrymen or game-dealers in London, and if it could have been