how little probability there is of migratory birds flying at great elevations, and that even in low latitudes, the temperature at altitudes exceeding four and a half miles would be prohibitory to the existence of the majority of migrants :—

Altitude.	Temp. F.	Temp. F.
′	°	°
0	+ 80	
5,000	+ 64·4	− 18·5
10,000	+ 48·4	− 37·8
15,000	+ 31·4	− 58·8
20,000	+ 12·0	− 82·1
25,000	− 7·6	−109·1
30,000	− 30·7	−140·3

Calculations by Mr. Glaisher's rule for approximate temperature (decrease of 1° F. for every 300 feet elevation) give less startling results than the above, but even then, with the thermometer marking 80° at sea level, we find that a temperature of 40° of frost must exist at five miles in height.

The advocates of the "sight theory" have rather more in their favour than Prof. Newton has conceded to them. It is not necessary that birds should fly at such heights as to literally view the land they guide their course to or by. The "loom" of land, so well known to sailors, is visible when the land itself is below the horizon ; and I do not think we are entitled to say that birds would not, equally with mariners, notice the indication. Then again the action of one flock of birds when in sight of land, might guide other more distant flocks, and these might influence birds still further off. We know how the circling downward swoop of a vulture on some discovered carrion will draw to the feast vultures from all parts of the sky. We know the power of our own vision, certainly inferior to that of many birds; and it is therefore well within the bounds of possibility that migrating birds, watchful because weary and hungry, may see and be influenced by the movements of flocks of their companions thirty to forty miles distant. A few flocks might thus bridge a wide expanse of barren ocean.

It is not necessary, however, to insist that sight alone is the guiding faculty in migration. The majority of, if not all, animals possess that marvellous "sense of direction" that has become so blunted in civilised man. Both savages and lower animals will find their way back in a "bee-line" through unknown country, to places whence they have been led by tortuous tracks. Why should not this "sense of direction" then guide birds over oceans without landmarks. The case of first migration of young birds (cuckoos and starlings) quoted by Prof. Newton, is, it must be confessed, a problem difficult to solve ; but when the journey has been once made by an individual bird in a flock I cannot see more mystery in the arrival of that flock at their destination than there is in the perfect accord between the hand and the eye of a good shot or a good billiard player.

We must all concur with Col. Donnelly in desiring further observations, with facility for publication and discussion, and I venture to hope that we shall see many more papers from Prof. Newton's pen on the subject. E. H. PRINGLE

Scientific Club, Savile Row, March 18

The Microtelephone

TOWARDS the end of last year I got constructed a telephonic apparatus which gives results much superior to those of the ordinary Bell telephone. Its construction is based on four principles, two of which have not yet been applied to telephones :—

1. The magneto-electric principles of the Bell telephone.

2. The microphonic principles of Hughes (different quantity of the points of contact).

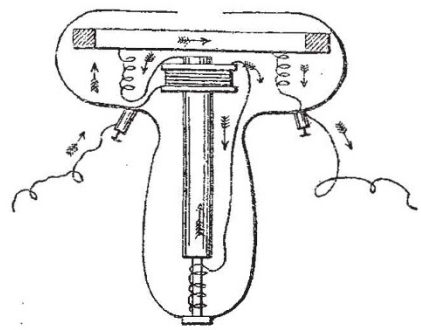
3. The principle discovered by Beatson and De La Rive (1845), and which explains the experiments of Messrs. Blyth and Hughes with the speaking microphone (production of sounds by the passage alone of a discontinuous or undulating electric current).

4. The principle that the intensity of the sound depends on the density of the air in which it is produced.

All the principles are combined in so simple a manner that the microtelephone differs from the Bell telephone only in the three following points :—

1. The electric current engendered by the approach or withdrawal of the iron membrane, traversed not only the bobbin, but also the magnet and the membrane itself.

2. The communication of the current with the vibrating plate of iron is effected by means of two small springs, which are lightly pressed by the membrane, and as this pressure may be more or less strong during the action of the apparatus, the latter acts as a microphone of a relatively weak sensitiveness, but which permits the telephone to be spoken to at a distance of several centimetres, and of hearing the ticking of a watch, or the sounds of a musical box with the aid of a carbon microphone.



3. Three millimetres above the iron membrane is another membrane of caoutchouc (which should not be very fine), and both membranes inclose a layer of air, moderately compressed, which in this way must vibrate, together with the two membranes.

The microtelephone is regulated once for all, and transmits the feeblest word with a truly perfect precision.

JULIAN OCHOVOWICZ

University, Lemberg, Galicia

Vacuum Tube Phenomena

HAS it been observed that the area of the exposed surface of the negative electrode in a highly exhausted vacuum tube exerts an important influence on the facility with which the discharge takes place?

I have recently been observing Crookes's molecular shadows with a tube constructed by Mr. J. Marr, of Liverpool, in which one electrode is a flat disk about 1 inch in diameter, and the other a piece of platinum wire about ¾ inch long. When these electrodes are connected with the terminals of an induction coil capable of giving a 4½-inch spark in air, and the contact-breaker arranged so that the shadows can just be seen when the disk is in connection with that terminal which becomes negative when the current in the primary wire is broken, a reversal of the commutator causes the discharge to cease.

If, now, the coil power be increased by the proper manipulation of the contact-breaker, a condition of things is reached in which the dark shadows flash out intermittently, even though the disk is connected with what is called the positive terminal of the induction coil.

This is evidently caused by the passage of the inverse induction current ; I mean that current which is produced when the circuit of the primary is completed. It thus appears that a condition of things can be obtained in which the effect of the greater electromotive force produced on the breaking of the primary circuit is counterbalanced by the influence of the relative size of the electrodes.

The above observation appears to be interesting, and as it may possibly be new, I venture to send you an account of it.

Nottingham, March 8 J. J. H. TEALL

Leibnitz's Mathematics

PROF. TAIT has recently given your readers one mathematician's opinion of Leibnitz as a discoverer. The following extract is serviceable in the same direction, while it has the further merit of attesting to the existence of a still later "vestige of presumption" than has yet been referred to. The extract is from a review by M. Bertrand of Dühring's "Kritische Geschichte der allgemeinen Principien der Mechanik" (Berlin, 1873). M. Bertrand says :—

Les sévérités de M. Dühring sont impartiales, et l'un des plus grands génies de l'Allemagne semble précisément le plus maltraité de tous. Les *Actes* de Leipzig, de 1684, donnèrent, est-il dit dans le texte, la première publicité à la théorie des fluxions de Newton, et en note, on ajoute: "Il n'a pas été possible d'opposer à Leibnitz des preuves complètes qui le