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	0
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 $\frac{3}{4}$ inch long. When these electrodes are connected with the terminals of an induction coil capable of giving a $\frac{1}{4}$ -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

forçassent à avouer son emprunt ; mais la connaissance de son caractère donne à l'acte qu'on lui reproche une probabilité voisine de la certitude. Une lettre d'Huyghens à L'Hospital est sur ce point fort instructive.

"M. Leibnitz," dit Huyghens, "est assurément très habile, mais il a avec cela une envie immodérée de paroître, comme cela se voit, lorsqu'il parle de son Analyse des infinis . . . , des lois harmoniques des mouvemens planétaires, où il a suivi l'invention de M. Newton, mais en y meslant ses pensées qui la gastent . . . Encore suis-je fort en doute, pour des raisons que je pourrais alléguer, s'il n'a pas tiré sa construction (de la chaînette) de celle de M. Bernoulli."

"Dans la préface de son 'Calcul différentiel,' Euler n'attribue

à Leibnitz que la réduction des principes de Newton en système. Lagrange, qui cherche chez Fermat l'origine du Calcul différentiel, ne manque pas, dans ses 'Leçons sur le Calcul des Fonctions,' de signaler les concordances de l'écrit de Leibnitz de 1684, avec la théorie antérieure de Fermat. Gauss pensait, comme on le voit dans l'écrit de Sartorius de Waltershausen, que Leibnitz, même de loin, ne doit pas être comparé à Newton."

It is satisfactory to quote Herr Dühring through his reviewer, because the introductory sentence of the extract makes evident to those not already aware of M. Bertrand's historical leanings that it is on Dr. Ingleby's side the eminent French mathematician would give his voice.

THOMAS MUIR

High School of Glasgow, March 17

Blue Flame from Common Salt

SOME time ago the question was raised in NATURE (vol. xiii. p. 287) concerning the origin of the blue flame produced when common salt is thrown into a hot fire.

Among the suggestions that were advanced, no one offered the only explanation that is at all feasible, viz., that it is due simply to hydrochloric acid.

The blue flame is not produced by sodium chloride only, but by other chlorides as well. Those I have tried are BaCl_2 , SrCl_2 , KCl , AmCl , Hg_2Cl_2 , and HCl , the last both in solution and as gas.

It would be waste of time and space to enumerate all the experiments I have made on this subject ; many of them were for the purpose of proving that neither carbon nor sulphur had any share in the reaction.

One of my methods of obtaining the flame was to burn pure hydrogen from a glass jet, and allow a mingled stream of HCl and NH_3 from two other jets to pass into it. The best source, however, is calomel, heated on wire gauze by a Bunsen burner ; the next best, AmCl .

The spectrum of the "chloride" flame is characterised by a series of double bands in the green, blue, and violet, the least refrangible of each pair being the broadest. The four pairs in the violet are especially prominent. There are two red bands or lines, and one orange. The least refrangible red line occupies the place of the hydrogen line C.

A spark between carbon points in a bottle of HCl gas yields a spectrum similar in appearance to that obtained from a chloride, but I was unable to see any violet bands, only a faint continuous spectrum.

I was able to ascertain that the red lines coincided exactly,

but I cannot affirm with the same positiveness that all the green lines and bands coincide. Some undoubtedly do, but the spectrum of the HCl was so faint, and the spectrum of the chloride so transient, that measurements were very difficult, and I do not pretend to any high degree of accuracy in my delineations of the lines, besides the different conditions under which the two were compared might account for considerable variations. For the HCl I used a coil (capable of giving a 2" spark) with Leyden jar, worked by six Smees. The carbon points were $\frac{1}{4}$ inch apart. The spark was tried both focussed and unfocussed on the slit of a 2-prism spectroscope. When comparing the two spectra side by side it was difficult in some cases to be sure of coincidence, because the flame from the Hg_2Cl_2 would flash out brilliantly for a moment and quite overpower the more feeble lines of the HCl ; it would then disappear entirely, and more chloride would have to be placed on the gauze.

I have no doubt in my own mind that HCl is the cause of the blue flame. I have proved that Cl is a necessary constituent, and I have not been able to get it in the absence of hydrogen (the spectrum of pure Cl is very different), and besides the red H-line is present in both cases, and probably the other two as well. I do not think that the presence of aqueous vapour is sufficient to account for the red line.

I subjoin the spectra as I mapped them, but it must be borne in mind that I do not vouch that they are free from error. I intend to photograph them when I have sufficient leisure, and I hope the results will be more definite. I may be able to find violet lines in the spectrum of HCl .

A. PERCY SMITH

Temple Observatory, Rugby,
March 15