published in the "Memoirs of the Paris Academy." It is singular that the original observations of this comet, given in "Francisci Blanchini Veronensis Astronomicæ ac Geographicæ Observationes selectæ" (Verona, 1737) have not, so far as we can discover, been fully calculated. The volume is not mentioned amongst those consulted by Pingré, in the preparation of his great work, the "Cométographie," and is probably rare. A preliminary reduction of these observations exhibits considerable difference from Burckhardt's parabola, and in presence of the suspicious indications of ellipticity, small inclination and direct motion, it may result that Bianchini's observations may be sufficient to add another comet of short period to those already known—at least so far as to render probable its having moved in an elliptical orbit of small extent, at the time it was observed, which is about all that can be said in the case of the comet of 1766, or of the first comet of 1743. It is certain that it must have been very near to the earth shortly before Bianchini discovered the comet on April 20. In a short time we may have more to say respecting the movements of this body.

THE TOTAL SOLAR ECLIPSE of 1999, AUGUST 11.—In NATURE, vol. xii. p. 213, were given the elements of the eclipse of 1927, June 28, which will be total in the north of England, though only for nine or ten seconds even on the central line; it is the first total eclipse that will be visible in these islands during the ensuing century, and there is only one other eclipse that can be witnessed in its totality in England before the year 2000. It is that of 1999, August 11, of which we proceed to give some account.

The elements of the eclipse are as follows:—

Conjunction in R.A. 1999, Aug. 10, at 22h. 50m. 8s. G.M.T.

| | | | | |
|---|---|---|---|---|
| R.A. ... ... ... ... ... | 140° | 46′ | 31″ | |
| Moon's hourly motion in R.A. ... ... | | 35 | 29 | |
| Sun's " " " ... ... | | 2 | 22 | |
| Moon's declination ... ... ... | 15 | 50 | 11 | N. |
| Sun's " ... ... ... | 15 | 19 | 49 | N. |
| Moon's hourly motion in decl. ... ... | | 7 | 44 | S. |
| Sun's " " " ... ... | | 0 | 44 | S. |
| Moon's horizontal parallax ... ... | | 58 | 43 | |
| Sun's " " ... ... | | | 9 | |
| Moon's true semi-diameter ... ... | | 16 | 0 | |
| Sun's " " ... ... | | 15 | 47 | |

The sidereal time at Greenwich mean noon on Aug. 11 is 9h. 18m. 2·0s., and the equation of time 5m. 16s. subtractive from mean time.

The central eclipse begins 21h. 29·4m. in long. 64° 49′ W., lat. 41° 11′ N.; central with sun on meridian in long. 18° 47′ E., lat. 46° 47′ N.; central eclipse ends 0h. 34·8m. in long. 87° 33′ E., lat. 17° 31′ N.

So far as regards this country the most favourable locality for observation will be in the vicinity of St. Ives, in Cornwall, which place is almost exactly on the line of central eclipse. Taking the position of St. Ives in long. 5° 26′ W., lat. 50° 12′ we find—

| | h. | m. | s. | |
|---|---|---|---|---|
| Beginning of totality August 11 at | 9 | 47 | 42 | A.M. local time. |
| Ending " " " | 9 | 49 | 42 | " " |

The duration of total eclipse is therefore 2·m.

The sun's apparent altitude at this time is 47°.

If we found equations of reduction upon this direct calculation for St. Ives, we shall have the following expressions by means of which anyone who is curious in the matter may examine the durations for such places as fall within the total eclipse:—

$$\text{Cos. } w = 70{\cdot}8267 - [2{\cdot}12739] \sin. l + [1{\cdot}70001] \cos. l, \cos. (L + 11^\circ\, 55'{\cdot}6)$$

$$t = 23\text{h. } 19\text{m. } 48\text{s. } \mp [1{\cdot}78051] \sin. w - [3{\cdot}27551] \sin. l$$
$$+ [3{\cdot}92586] \cos. l, \cos. (L - 114^\circ\, 40'{\cdot}1).$$

In these formulæ $l$ is the geocentric latitude, $L$ the longitude from Greenwich taken *negative*, and $t$ the Greenwich mean time of beginning or ending, according as the upper or lower sign is employed; the quantities within the square brackets are logarithms.

For that portion of the zone of totality falling upon English ground we have—

| Long. W. | | Lat. North Limit. | | Central Eclipse. | | South Limit. |
|---|---|---|---|---|---|---|
| 2° 30′ | ... | 50° 35′·9 | ... | 50° 8′·2 | ... | 49° 40′·5 |
| 3 30 | ... | 50 38·2 | ... | 50 10·5 | ... | 49 42·8 |
| 4 30 | ... | 50 40·4 | ... | 50 12·6 | ... | 49 45·0 |
| 5 30 | ... | 50 42·2 | ... | 50 14·5 | ... | 49 46·9 |

These results may be expected to prove pretty near the true ones, being derived from elements of the lunar motions which represent with considerable precision the circumstance of the total eclipse in England in 1715, and the annular eclipse of 1737, which was well observed at Edinburgh by Lord Aberdour and Maclaurin.

THE ZODIACAL LIGHT.—This phenomenon presented itself rather conspicuously in the neighbourhood of London on the evening of the 23rd inst., though the vaporous condition of atmosphere seriously interfered with any attempt to trace its outlines satisfactorily. The southern border of the light appeared to be better defined than the northern one, and the latter seemed to be slightly curved.

## *THE THEORY OF "STREAM LINES" IN RELATION TO THE RESISTANCE OF SHIPS* *

### IV.

### SUPPLEMENTARY NOTES.—A.

THE proposition, that the flow of fluid through a tortuous pipe when its ends are in the same straight line, does not tend to push the pipe endways, can be treated in several ways, of which only one is given in the text of the address; but it may be interesting to some readers to trace some of the other ways of viewing the question.

First let us take the case of a right-angled bend in a pipe (that is to say where the direction of a pipe is altered through a right-angle by a curve of greater or less radius; a bend of this sort is shown in Fig. 29), and assume that the fluid in it at A is flowing from A towards C. I propose at present to deal only with those forces or tendencies which act more or less powerfully in the direction of the original motion of the fluid, namely along the line AC.

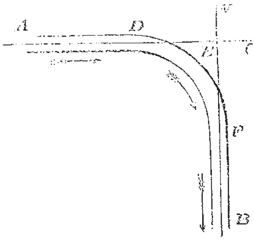

FIG. 29.

I must here remind you that I am dealing with this matter entirely independently of hydrostatic pressure. Perhaps to some it will be difficult to dissociate the idea of hydrostatic pressure from a fluid in a pipe. This difficulty might be got over by assuming that the pipe is immersed in a fluid of the same density and head as the fluid within it. There will thus be hydrostatic equilibrium between the fluid within and without the pipe, the only difference being that the fluid inside the pipe is assumed to be in rapid motion, and thus to subject the pipe independently to any stresses properly incidental to that motion of the fluid within it.

The sole work that has to be done in the present case, is that of deflecting the current of fluid to a course at right angles to its original course AC; and, regarding these forces as resolvable throughout into two sets of components, the one at right angles to the line AC, the other parallel to it, it is of the latter alone that account is to be taken. Manifestly the sum of these components is measured by the circumstance that it is precisely sufficient to entirely destroy the forward momentum of the fluid that flows

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* Address to the Mechanical Section of the British Association, Bristol, August 25, 1875; by William Froude, C.E., M.A., F.R.S., President of the Section. Revised and extended by the author. Continued from p. 133.

along the pipe at A towards the bend. This force is administered to the fluid by the curved portion of the pipe at the bend DEF; and as the pipe is assumed to be rigid, the work of arresting the forward velocity of the fluid throws a forward stress on the pipe in a direction parallel to the line AC.

Let us now assume that to the right-angled bend AB we attach rigidly a second right-angled bend, BG, as shown in Fig. 30, in such a manner that the termination of this second bend at G is parallel to the commencement of the first bend at A. Here I will again, for the present, deal only with the forces in a direction parallel to the line AC.

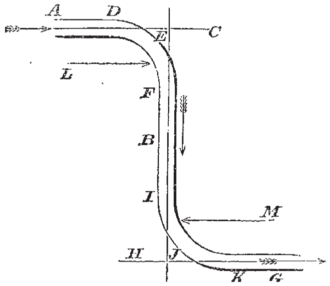

FIG. 30.

The fluid at B has no velocity in the direction of the line AC, and at G it has a velocity in that direction equal to the velocity which it had at A. To give it this velocity in a forward direction (I mean forward in its original direction of motion), to establish this forward momentum, requires the application of a force in the direction HG; and this force is administered to the fluid by the curved portion of the pipe at the bend IJK; and as the pipe is assumed to be rigid, the duty of establishing the forward velocity of the fluid throws a rearward stress on the pipe in the direction GH. Now as the forward momentum given to the fluid between B and G in the line GH is exactly the same as the momentum destroyed between A and B in the line AC, it follows that the rearward stress thrown on the pipe at the bend IJK is exactly equal to the forward stress thrown on the pipe at the bend DEF. Hence it will be seen that the forces acting on the rigid pipe AG, treated as a whole, balance, so far as relates to the forces parallel to the line AC, the original line of motion of the fluid—the forward stress acting on the pipe at the bend DEF being balanced by the equal rearward stress acting on the pipe at the bend IJK. These two of the forces acting on the pipe are shown by the arrows L and M, which, it must be remembered, are the only forces which act in a direction parallel to the line AC.

It will have been seen that the measure of these forces is the amount of forward momentum of the fluid which is destroyed or created; and from this it will be inferred that the forces will be the same, no matter what is the radius of the curve of the pipe, inasmuch as the curvature of the pipe does not affect the amount of the forward momentum that has to be destroyed or replaced in the fluid.

Let us next take the case of a bend in a pipe that is not a right angle, as shown in Fig. 31; and here, as before, I only propose to deal with the forces that operate in a direction parallel to the line AC, that is, of the original motion of the fluid. Now in this case the forward motion of the fluid is not, as in the instance of the right-angled bend, entirely destroyed in its progress from A to A; only a portion of the forward motion is checked, and the same portion of the forward momentum destroyed; and the force by which it is destroyed is administered to the fluid by the curved portion of the pipe at the bend DEF, and, as in the former case, constitutes a forward stress on the pipe in the direction of the line AC, which will bear the same ratio to the stress which would follow from the destruction of the whole, as the portion destroyed bears to the whole forward momentum.

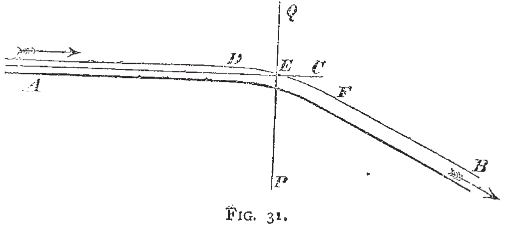

FIG. 31.

Suppose to this bend we attach rigidly another bend BG, of same angle, as shown in Fig. 32, so that the termination of this second bend at G is parallel to the commencement of the first bend at A. Here, in the portion of the pipe BG, that part of the forward velocity which was taken away has to be again given to the fluid; this requires force, which is administered to the fluid by the curved part IJK of the pipe. There is thus thrown on the pipe a rearward stress represented by M. The force required in the bend between B and G to reinstate completely the forward velocity, is evidently the same in amount as the force required in the bend between A and B to destroy in part the forward velocity.

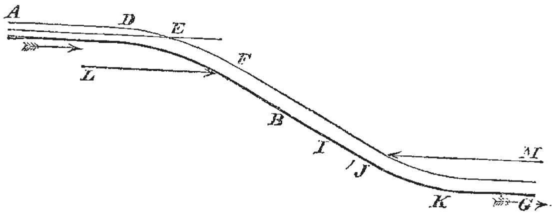

FIG. 32.

It follows, therefore, that the two stresses on the pipe, represented by the arrows L and M, which indicate the forces acting on the pipe, are equal and opposite to one another, and these are the only forces acting on the rigid pipe in a direction parallel to the line AC or the original motion of the fluid at A. It follows, therefore, that in case of two right-angled bends rigidly connected, or in the case of two connected equal-angled bends of any other angle, the stresses brought on the pipe by the flow of the fluid will not tend to move the pipe bodily endways.

It will be seen also by this reasoning that the forces we have referred to do not depend on the curvature of the pipes, but are simply measured by the amount of the forward momentum of the fluid and the extent to which that momentum is modified by the total of the deflection which the course of the fluid experiences in passing the bend, or, in other words, by the angle of the bend. And from this reasoning it becomes apparent that by whatever bends or combinations of bends we divert the course of a stream of fluid in a pipe, provided the combination be such as to restore the stream to its original direction, the aggregate of the forces in one direction required to destroy forward momen-

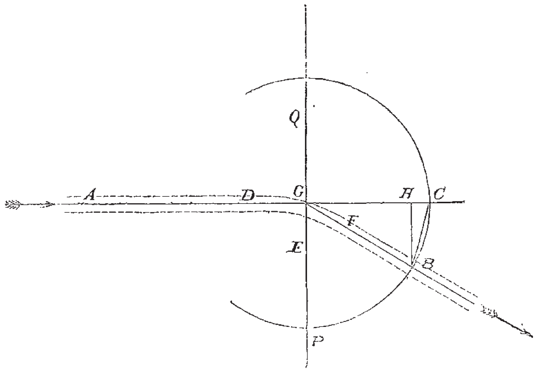

FIG. 33.

Let AGB = angle of bend.
Let GC = force required to destroy the whole momentum of fluid in line AC.
,, = tension which would be put on pipe AD by a right-angled bend.
Then HC = force required to destroy momentum lost at the bend in the line AC.
And HB = force required to establish momentum acquired at bend in line QP.
∴ BC = total force acting on pipe.
This force must be in equilibrium with the tensions of pipe along BG and AC.
∴ the tension of pipe = GC or GB.
*i.e.* = the tension of pipe when the bend is right angled.
Therefore the tension of the bent pipe is constant for a given velocity of flow, whatever be the angle of the bend.

tum are necessarily balanced by equal forces in the opposite direction required to reinstate the former momentum.

It will be useful to consider more in detail the action of all the forces operating on a fluid in a bend of the pipe; and I will return to the case of a single right-angled bend, as shown in Fig. 29. I before spoke merely of the forces acting parallel to the line AC, and said that the forward momentum of the fluid in that line had to be destroyed in its passage round the bend DEF, and that this must be effected by a force acting parallel to AC, which would throw a forward stress on the pipe, tending to force it in the direction AC. But similarly velocity has to be given to the fluid in the direction NB; and to do this a force must be administered to the fluid which will cause a reaction on the pipe in the direction BN; and as the momentum to be established in the direction NB has to be equal to that in the direction AC, which had to be destroyed, it follows that the forces of reaction upon the pipe in the directions AC and BN are equal. These forces can be met in two ways, either by securing the bent part of the pipe DEF so that it will in each part resist the stresses that come on it, or by letting the forces be resisted by the tensional strength of the straight parts of the pipe AD and BF operating in the direction of their length; and in this case we see that the tension on AD must be equal to the force acting along AC, and the tension on BF must be equal to the force acting along BN, so that in fact the forces brought into play by the right-angled bend produce a longitudinal tension on the pipe at either end of the bend equal to the force required to destroy the forward momentum of the fluid.

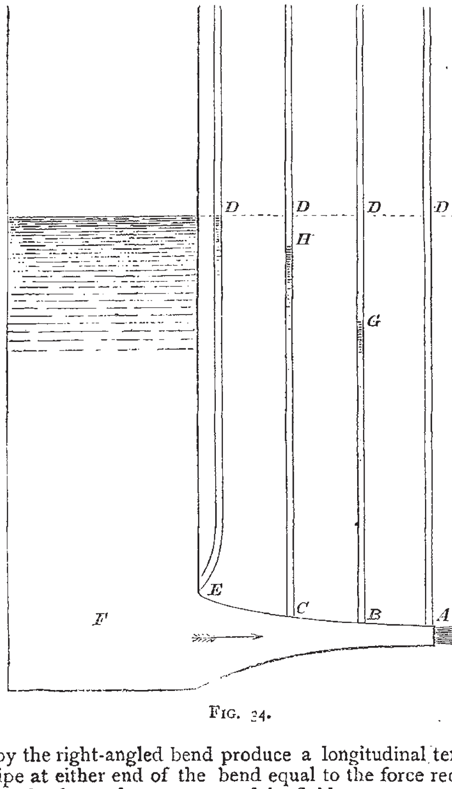

Fig. 34.

Proceeding to the case of the non-right-angled bend, as shown in Fig. 31: in this case, as we have seen, a portion only of the forward momentum of the fluid in the line AC has to be destroyed, also a certain amount of sideways momentum has to be created in a direction which we may consider parallel to the line QP; and the composition of the remaining forward momentum in the line AC with the created sideways momentum in the line QP, results in the progress of the fluid along the path FB; this partial destruction of forward momentum and establishment of some sideways momentum are essential to the onward progress of the fluid along FB. The bend DEF will be subject to the reaction of the forces necessary to produce these changes; and either the bend may be locally secured, or the stress upon it may be met, as in the case of the right-angled bend we have just been considering, by a tensional drag on the pipe at either end of the bend. There is, however, this difference between the cases, that the force required to establish sideways momentum parallel to QP cannot be directly met by the reaction of tension along the line BF of the second part of the pipe; but this force may be met by the obliquely acting tension of the pipe BF combined with the induced tension along the pipe AD. It is well known that in the case of a given force, such as that we are supposing parallel to PQ, resisted by two obliquely placed forces such as the tension along the lines DA and FB, the nearer the lines DA and FB are to one straight line, the greater must be the tension along those lines to balance a given force acting on the line PQ. Now the less the line FB diverges from the line AC, the less will be the sideways momentum parallel to QP that has to be imparted to the fluid; but at the same time and to precisely the same extent will the proportionate tension put upon the limbs DA and FB of the pipe be aggravated by the greater obliquity of their action. The sideways pull is greatest when the bend is a right angle; and then it amounts to a force that will take up or give out the entire momentum of the fluid, and it is supplied directly by the tension of the limb of the pipe at FB. If the bend is made less than a right angle, the less the bend is made, the less is the sideways pull, but the greater by the same degree is the disadvantage of the angle at which the tension on the pipe resists the pull; and it results from this that in the case of a bend other than a right angle, the tension on the pipe is the same as in the case of a right-angled bend. A geometrical proof of this is given in Fig. 33. It is evident that the radius of curvature of the bend does not enter into this consideration, and that the forces acting are not affected by the rate of curvature of the pipe, the simple measure of the forces being the increase or decrease in the momentum of the fluid in each direction. It results from this that if a fluid be flowing along a pipe with a bend in it, no matter what may be the angle of the bend, or the radius of its curvature, the reactions necessary to deflect the path of the fluid will be met by a tensional resistance along the pipe; and this tension is equal to the force that would be required to entirely destroy the momentum of the fluid.

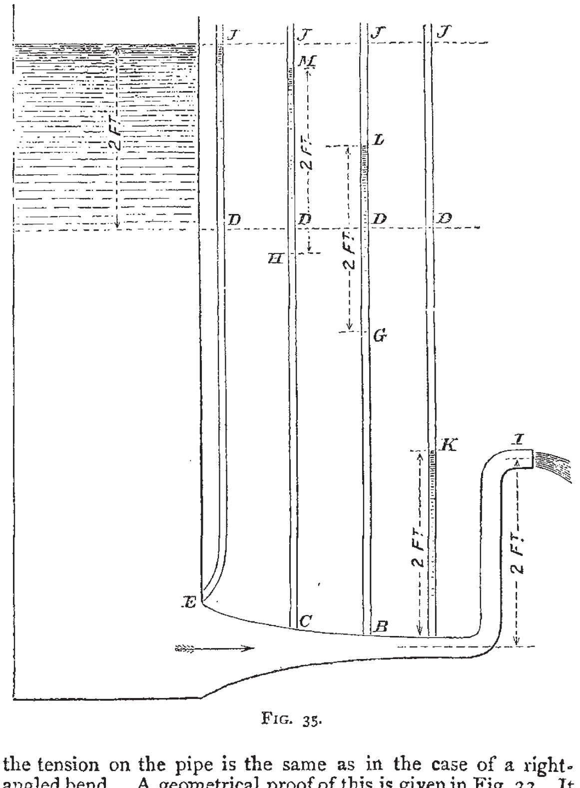

Fig. 35.

If we now assume any number of bends, of any angle or curvature, to be connected together (see Fig. 3), the equilibrium of each bend is satisfied by a longitudinal tension which is in every case the same; and this tension is therefore uniform throughout the pipe; for the tension at any intermediate point in a bend is clearly the same as at the ends of the bend, as we may suppose the bend divided at that point into two bends, and there joined together by an infinitely short piece of straight pipe.

If, then, the tortuous pipe I have above referred to has its ends at A and B parallel to one another, as shown in Fig. 4, it is clear that the tensional forces at its ends balance one another, and the pipe, as a whole, does not tend to move endways.

### NOTE B.

The law regulating these changes of pressure due to changes of velocity can be best understood by considering the case of a stream of perfect fluid flowing from a very gradually tapered pipe or nozzle placed horizontally and connected with the bottom of a cistern, as shown in Fig. 34. Let us suppose that at the points B and C the sectional areas of the pipe are severally twice and four times that at the point of exit A.

At the point of exit A the fluid is under no pressure whatever, since there is no reacting force to maintain any pressure; each particle of fluid in the issuing jet is rushing forward on its own account, neither giving nor receiving pressure from its neighbours. We know, however, what force it has taken to give the velocity which the fluid has at the point of issue A, and we measure this force by the pressure or head of fluid, lost. In the case we are considering, this head is represented by the height of the fluid in the cistern, or by the height AD.

Within the cistern, at the point E, on the same level as A, the point of issue—at this point E within the cistern, we have in effect the whole pressure due to the head of fluid equal to AD, but we have no velocity, at any rate the velocity is so small as to be inappreciable; and at the point of issue A we have no pressure at all, but we have what is termed the "velocity due to the head."

Let us suppose that at the points A, B, C, and E, gauge-glasses or stand pipes are attached so that the fluid in each may rise to a height corresponding with the pressure within the pipe or nozzle at the point of attachment.

The gauge-glass attached at A will show no pressure, thus indicating that the entire head AD has been expended in producing the velocity at the point A.

At the point B, as the sectional area is twice, the velocity is one-half that at A. Now the head required to produce velocity varies as the square of the velocity to be produced; in other words, to produce half the velocity requires one quarter of the head; thus of the whole head AD available, one quarter only, or GD, has been absorbed in developing the velocity at B, and the remainder of the pressure, which will be represented by the head BG, will be sensible at the point B, and will be exhibited in the gauge-glass attached at that point.

Again, as the pipe at C is four times the area that it is at A, it follows that, of the whole head AD, one-sixteenth part only, or HD, has been absorbed in developing the velocity at C, and the remainder of the pressure, which will be represented by the head CH, will be sensible at the point C, and will be exhibited in the gauge-glass attached at that point.

In the case I have chosen for illustration, the small end, A, of the nozzle, is open and discharging freely, and the pressure at that point is therefore *nil*. But the absolute differences of pressure at each point of the pipe or nozzle will be precisely the same (as long as the same quantity of fluid is flowing through it per second), however great be the absolute pressures throughout.

Thus, suppose that from the end of the nozzle at A a pipe of the same diameter, and of uniform diameter throughout its length, is curved upwards, so that the end of it, I, is two feet higher than A, as shown in Fig. 35, if the level of the cistern is also raised two feet, namely to the level marked J, instead of D, we shall have the same delivery of fluid as before; and the differences between the pressures at each point will be the same as before.

If we add 50 feet instead of 2 feet to the head in the cistern, and raise I to 50 feet, instead of 2 feet above the nozzle, the differences of head or pressure will still be the same, the head at A being 50 feet, that at B being BG + 50 feet, that at C, CH + 50 feet, and that at E (the cistern-level) ED + 50 feet.

To put the case into actual figures, suppose the sectional area at A to be 1 square inch, that at B 2 square inches, and that at C 4 square inches, and suppose that the fluid is passing through the nozzle at the rate of one-ninth of a cubic foot per second, we shall have a velocity at A of 16 feet per second, to generate which would require a difference of pressure between E and A, equivalent to 4 feet of vertical head. The velocity at B will be 8 feet per second, which would require a difference between E and B equivalent to 1 foot of head. That at C will be 4 feet per second, and will require a difference of pressure equivalent to 3 inches of head. If the pressure at A be zero, the pressures at B, C, and E will be 3 feet, 3 feet 9 inches, and 4 feet respectively. If the pressure at A be 1 foot, the pressures at B, C, and E will be 4 feet, 4 feet 9 inches, and 5 feet respectively; and if the pressure at A be 1,000 feet, the pressures at B, C, and E will be 1,003 feet, 1,003 feet 9 inches, and 1,004 feet respectively, always supposing the quantity of fluid passing per second to be the same. If the quantity be different, the absolute differences of pressure will be different, but will be relatively the same. If, for instance, the quantity flowing per second be doubled, the velocity at each point will be doubled, and the differences of pressure quadrupled; so that if the pressure at A were again 1,000 feet, those at B, C, and E would be 1,012, 1,015, and 1,016 feet respectively.

To sum up—the differences of hydrostatic pressure at different points vary as *the differences of the squares of the velocities* at those points.

### NOTE C.

Here again the argument given in the text suggests certain other lines of argument which some persons may feel interested in following out

Suppose each and every one of the streams into which we have subdivided the ocean, to be inclosed in an imaginary rigid pipe made exactly to fit it, throughout, the skin of each pipe having no thickness whatever. The innermost skin of the innermost layer of pipes (I mean that layer which is in contact with the side of the body), the innermost skin, I say, of this layer is practically neither more nor less than the skin or surface of the body. The other parts of the skins of this layer, and all the skins of all the other pipes, simply separate fluid from fluid, which fluid, *ex hypothesi*, would be flowing exactly as it does flow if the skins of the pipes were not there; so that, in fact, if the skins were perforated, the fluid would nowhere tend to flow through the holes. Under these circumstances there clearly cannot be any force brought to bear in any direction by the flow of the fluid, on any of the skins of any of the pipes except the innermost skin of the innermost layer. Now, remembering that we are dealing with a perfect fluid which causes no surface-friction, we know that the fluid flowing through this system of pipes administers no total endways force to it. But it produces, as we have just seen, no force whatever upon any of the skins which separate fluid from fluid; consequently, if these are removed altogether, the force administered to the remainder of the system will be the same as is administered to the whole system, namely, no total endways force whatever. But what is the remainder of the system? Simply the surface of the body, which is formed, as I have already said, by the innermost skins of the innermost layer of pipes. Therefore no total endways force is administered to the surface of the body by the flow of the fluid.

Lastly, let us recur for an instant to the case of fluid flowing through the single flexible pipe. Here it was proved that the flow of the fluid through it, if it was anchored at the two ends, did not tend to displace any part of it, because the centrifugal forces produced by the flow of the fluid, and which must act exactly at right angles, or normally, as it is called, to the line of pipe at each point, are exactly counterbalanced by a uniform tension throughout the length of the pipe. If the flexible pipe has variations in its diameter, the differences of quasi-hydrostatic head appropriate to those variations are also normal to the surfaces of the pipe, being simply bursting-pressures. If, however, these normal forces were directly counterbalanced by equal and opposite and normal external forces or supports, it is obvious that this tension would be entirely relieved. Now, if we suppose the system of pipes which we have several times already imagined to surround the submerged body, to be flexible pipes (instead of rigid pipes, as we have before imagined them), the counterbalancing, or normal, external forces which exactly relieve the tension are supplied to each pipe by its neighbour, except in the case of the innermost skin of the innermost layer of pipes, since this innermost skin has no neighbour. In this instance the counterbalancing, normal, external forces are supplied by the rigidity of the surface of the body. Now we know that, since the tensional forces produced by the flow of fluid through a flexible pipe, whether of uniform or varying sectional area, have no sum total of endways force, the counterbalancing forces which exactly relieve this tension must also have no total endways force; and since the counterbalancing forces acting throughout the whole system have thus no sum total of endways force, it can be proved, as before in the case of the similar system of rigid pipes, that if we remove the whole of the skins or sides of pipes, which separate fluid from fluid and which are all therefore necessarily in perfect equilibrium, the forces acting on the remainder, namely, on those skins which are in contact with the surface of the body, forces which therefore may be considered as acting simply upon the body, must also have no endways sum total.

## THE MELBOURNE OBSERVATORY

THE Board of Visitors to this Observatory made its annual visitation on June 2, 1875. Mr. Ellery, the Government Astronomer, having obtained leave of absence, the Board found the staff of officers and all the instruments in charge of Mr. White, in whose management it unhesitatingly expresses its fullest confidence.

The buildings and instruments are in good condition, and several new and important instruments have been added to the establishment during the period under notice. These include a photo-heliograph from Dallmeyer, of London, who constructed it under the advice of Dr. Warren de la Rue; an equatorial refractor of eight inches aperture, made by Troughton and Sims, under the advice of Sir George Airy; a portable equatorial, of 4½ inches aperture, by Messrs. Cook and Son, of York; and a double-image micrometer by Mr. Browning.

The various publications of the Observatory are in a forward condition. The First Melbourne General Catalogue of 1,227 Stars, for the epoch 1870, was published early in October, in time to be distributed among the different parties charged with the observation of the transit of Venus, by whom its great utility was acknowledged.

The observatory staff had much work to do in connection with the observation of the transit of Venus, not only having to make the necessary preparations for observing the transit at their own stations, but also to assist with the requisite observations for finding the positions of the stations occupied by the different nations in that part of the world. The arrangements made by the Observatory were all that could be desired.

With regard to the ordinary work of the Observatory, Mr. White reports as follows:—

"The work with the transit circle has consisted of the usual standard stars for finding the time, and the position of the instrument; close circumpolar stars, low stars for refraction, stars with which bodies had been compared off the meridian, stars culminating with the moon, the moon itself, and stars whose places were required by outside observers for any special purpose.

"The numbers of the recorded observations are as follows:—R.A. observations, 2,064; P.D. observations, 1,150; Observations of error of collimation, 111; observations of error of level and nadir, 180; observations of error of runs of microscopes, 47; observations of error of flexure, 35.

"The state of the reductions is as follows:—

"R.A. observations up to date.

"P.D. observations.—The stars observed in 1873 are reduced with the exception of 212, which require the corrections to reduce them from their apparent to their mean places. Of the stars observed in 1874, 865 are wholly unreduced, 267 have the reductions applied as far as the refraction, 45 are reduced to their apparent places, and the remaining 45 are fully reduced. Of the stars observed during the present year, 184 are fully reduced, 46 are reduced to their apparent places, and 122 are wholly unreduced. . . .

"The magnetical and meteorological instruments are under the special charge of Mr. Moerlin. Absolute values of the magnetic elements have been made as usual once a month, and they are all reduced up to date. The photographic curves from the magnetographs, barograph, and thermographs, are developed on every alternate day, but as yet no general tabulation of them has been made; only occasional measures are taken from them for special purposes. The ordinary meteorological observations made at Melbourne and the different stations in the colony are reduced to date; the Monthly Records in Meteorology and Magnetism are prepared to the end of April, and are in the printer's hands; owing to press of work, however, in the Government Printing Office, the Records to the end of December 1874 only have as yet been received. The Yearly Report for 1873 is in hand, and that for 1874 will be prepared as soon as possible.

"The great telescope, under the especial charge of Mr. Turner, has been diligently worked during the last twelve months, except during the time that we were engaged in the special observations connected with the transit of Venus, when Mr. Turner took turns with Mr. Moerlin in observing the occultation of stars by the moon. In accordance with the strongly expressed opinion of the Board in the last Report, the work done has consisted principally of drawing the nebulæ, and mapping the neighbouring stars; ten of the nebulæ and clusters figured by Sir John Herschel have been carefully drawn, and the positions of the stars have been laid down from micrometric measurements. One nebula has been observed which is not to be found in any catalogue in our possession. Coggia's comet was examined on eighteen nights, and fifteen drawings of it obtained. A drawing of the nebula surrounding $\eta$ Argus, with the stars accurately plotted in, made this year, shows no appreciable change when compared with the one made last year.

"Besides the occultation of stars by the moon, referred to before, and of which ninety-six were looked out for, and only fifteen observed, owing to the unfavourable weather of the time, a fine series of observations for positions of Coggia's comet was obtained by Mr. Ellery and myself; an observation of Encke's comet was also obtained during the present month; all of which, including the occultations, have been sent for publication to the *Astronomische Nachrichten*."

The Report concludes with a brief account of the results obtained at the four Government stations during observations of the transit of Venus.

## PROF. PARKER ON THE WOODPECKERS AND WRYNECKS

ANOTHER admirable paper by Prof. Parker, exhibiting the same industry, successful elucidation of detail, and mastery of morphological principle that have characterised all his publications, appears in the recently-issued volume of "Transactions of the Linnean Society." It is chiefly devoted to an exposition of the palatal structures of the Picidæ and Yungidæ, made intelligible by the study of nestlings and young birds. The conclusions of Prof. Huxley in his paper in the "Proceedings of the Zoological Society" for 1867 are substantiated and placed on a broader basis; and thereby another chapter has been permanently added to the history of the connection between Reptiles and Birds. The assistance which scientific naturalists all over the world may render to necessarily sedentary students like Mr. Parker, by the preservation and transmission of young specimens of various ages, is nowhere more clearly manifested than in the paper now spoken of. Mr. Parker's study of Woodpeckers, both of hard and soft parts, dates from the year 1843; and the unpublished results of that labour, in the form of minutely-careful drawings, are still of considerable value for reference. Again and again the study was resumed, with somewhat unsatisfactory results, until the opportunity of dissecting young birds and of comparing them with southern species threw sufficient illumination on the difficult problem of their palatal structure.

An introduction to the paper serves to point out the proper relations between the zoologist and the embryologist. "Each kind of labourer," says Prof. Parker, "has the greatest need of the results brought out by the other: the patient dissector waits for the treasures supplied to him by the more mercurial taxonomist; whilst he, in turn, profits by the work of one to whom a single type may serve for the labour of a year or more. Yet both are learning to look beneath the surface of things, a growing knowledge of the types showing both that close kinship is often marked by great difference in outward form, and that it is easy to be beguiled by the external likeness of forms—*isomorphic*, indeed, but far apart zoologically."

A defence is made against those who would accuse the author, as well as Prof. Huxley, "of taking a narrow view of the bird-types, touching with the point of a needle some little tract, but unacquainted with and not able to appreciate the Bird as a whole." Such an accusation charges the broadest-minded men with possessing a cast of mind which would utterly disqualify them for the distinguished positions they hold. In the present case the exclusive description of the palatal structures is easily defended: for "that territory contains parts that have undergone the greatest amount of metamorphosis of any in the whole body of a high and noble vertebrate; and moreover, being in the bird the skeletal framework of the whole upper face, these parts are, as it were, an index of the amount of specialisation undergone by any particular type—the ruling determining structures that lead to all, and really demand all, the changes that take place in the rest of the organism."