as to be pulverizable. After being powdered, it was again digested and washed with alcohol until nothing more was dissolved. When dried at 100° C. it had the appearance of a semi-transparent horny substance, and was sufficiently elastic to render pulverization difficult. The alcohol contained in solution a quantity of sugar of a brownish colour, quite uncrystallizable, and rendered sour by the presence of the acid used in the manufacture.

The gummy substance treated with cold water slowly reassumes its original appearance. When treated with a large quantity of boiling water it forms a mucilage, which filters with difficulty. Iodine produces no effect on the solution. Subjected to Trommer's test for dextrine, sugar and gum, this did not indicate the presence of any of these substances. With nitric acid it produces oxalic acid. It gives a precipitate with diacetate of lead. It contains, after having been washed with alcohol, a small quantity of ashes, amounting to 1·37 per cent. It was analysed in the usual manner.

I. 0·746 of substance gave, with oxide of copper and chlorate of potash, 4·070 HO and 1·1735 CO_2 = 0·04727 H and 0·32448 C.

II. 0·1525 of substance gave 0·092 HO and 0·232 CO_2 = 0·010222 H and 0·06474 C.

These numbers, allowance being made of the ashes, give the following proportions:—

	I.	II.	Atoms.	Calculated.
Carbon . .	43·80	43·31	24	43·71
Hydrogen .	6·14	6·80	21	6·25
Oxygen . .	50·06	49·89	21	50·04

From this it would appear that this gummy substance is isomeric with cellulose and inuline*.

This substance, which has a composition similar to cellulose and inuline, is evidently formed from the cane-sugar in the lemonade, as all its other constituents exist in too small quantity to admit the idea of their having been its origin.

* Cellulose, Payen. Endine.

Carbon .	43·40
Hydrogen	6·12
Oxygen .	50·38[a]

From turnip. Fromberg.

Carbon .	43·95
Hydrogen	6·13
Oxygen .	49·66[b]

Inuline. Parnell.

Carbon .	43·95
Hydrogen	6·30
Oxygen .	49·75[c]

From Dahlia root. Payen.

Carbon .	44·19
Hydrogen	6·17
Oxygen .	49·64[d]

[a] *Ann. des Sc. Nat.*, 1840, p. 73. Bot.
[b] Mulder, *Op. cit.*, p. 203.
[c] Phil. Mag., vol. xvii. p. 126.
[d] *Op. cit.*, p. 91.

2 atoms sugar	C 24	H 22	O 22
1 ... water		H	O
1 ... gummy substance	C 24	H 21	O 21

This substance is formed then from 2 atoms of sugar by the abstraction of 1 atom of water.

As a solution of the gummy substance gave a compound with lead, we endeavoured to obtain by its aid its atomic weight. 0·260 of the precipitate gave of lead and oxide of lead quantities equal to 0·316 oxide of lead, which, when allowance is made for ashes, is equal to 55·8 per cent. of oxide of lead. We had not enough of the salt to enable us to make the combustion, but have calculated the formula from the quantity of lead.

		Atoms.	Calculated.
Carbon .	19·31	24	1834·4 = 18·7
Hydrogen	2·76	21	260·0 = 2·7
Oxygen .	22·11	21	2100·0 = 21·4
PbO . .	55·80 found	4	5578·0 = 57·1

From 55·8 per cent. oxide of lead the atomic weight found is 4400·0. The calculated one is 4198·4.

We had imagined that this curious change in sugar might have been the effect of organization, but our friend Mr. John Goodsir was kind enough to examine the substance, and informed us that he could discover no trace of organization.

V. *Remarks on* Professor Challis's *Theoretical Explanation of the Aberration of Light. By* G. G. Stokes, *M.A., Fellow of Pembroke College, Cambridge**.

THERE are a few points connected with Prof. Challis's paper on the Aberration of Light, published in the number of this Magazine for November 1845, respecting which I wish to offer a few remarks.

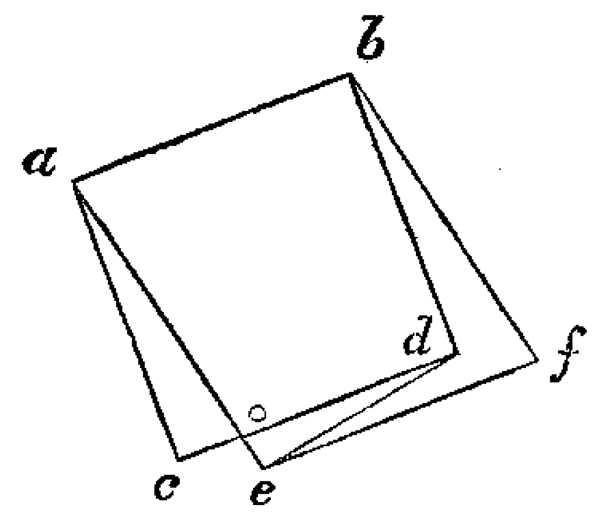
In the first place I perfectly agree with Prof. Challis, that the explanation of aberration is really independent of the manner in which light may pass through the eye; but I cannot agree with him that it is necessary to suppose that we see a star in its true place, and that it is the wire of the telescope with which it is observed that is affected by aberration. The following mode of viewing the subject, due to Boscovich, will perhaps put the matter in a clearer point of view.

If we wish to determine the real or apparent direction of an object, we may, theoretically speaking, adopt the following plan:—Let two small circular holes be so adjusted that the

* Communicated by the Author.

light from the object which passes through the centre of the one shall also pass through the centre of the other. The line joining the centres of the holes will then determine the direction of the object. Now this is, in principle, just what is done in the case of an astronomical instrument, only, the fixed points are replaced by the optical centre of the object-glass of the telescope with which the object is viewed, and by the wire to which it is referred. When the image of a star is bisected by the wire, we define the apparent direction of the star to be that of the line joining the optical centre of the object-glass with the bisecting wire. Whether it is the wire or the star which is seen out of its true place, is a question with which we have no concern. The answer which we shall be disposed to give to it depends on the theory of aberration which we adopt. According to the theory of aberration which I explained in the July number of this Magazine, the answer would of course be, that it is the wire which is seen in its true place.

The principal thing, however, to which I object in Prof. Challis's paper, is the reasoning by which he establishes his equation (5.). In the figure, $a\,b$ is a very small portion of a wave of light, which in the small time t would be propagated to $c\,d$ if the æther from a to b were moving with the velocity of the æther at b, while, in consequence of the difference in the velocity of the æther at a and b, the disturbance at a is propagated to e. Now Prof. Challis takes $c\,a\,e$ for the angle through which the normal to the wave's front is displaced as the wave passes from $a\,b$ to $e\,d$. But $a\,e$ is only the direction in space along which the disturbance at a is propagated, a direction which has no immediate relation to the normal to the wave, inasmuch as it differs from it by an angle which is of the order of the aberration, the very order of quantities that we are considering. In fact, according to the reasoning in my paper, to which Prof. Challis does not appear to object, I found that the law of aberration does not result from supposing the waves of light to be carried by the moving æther, so long as its motion is taken arbitrary; and in order to explain aberration, I was *compelled* to suppose $udx+vdy+wdz$ to be an exact differential, at least when the square of the aberration is neglected.



It is evidently immaterial whether we make the construction that Prof. Challis has given, or suppose $e\,f$ to be the position into which the wave $a\,b$ would come at the end of the

time t, in consequence of the velocity of propagation combined with the velocity of the æther at a, and suppose that f is brought to d in consequence of the difference of velocity of the æther at a and b. It is easy to show that $d\,f$ is equal and parallel to $c\,e$; so that, according to *this* construction, the normal to the wave ought to be displaced by the motion of the æther through the angle $f\,b\,d$ from $f\,b$ to $d\,b$, which is just the contrary direction to that given by Prof. Challis's construction.

Prof. Challis seems to think that the undulatory theory of light cannot be maintained unless it can be shown that the law of aberration ought to be the actual law, *whatever* may be the motion of the æther. But it is surely sufficient to show that a conceivable kind of motion exists which would lead to the observed law of aberration, provided we have no reason for regarding that sort of motion as improbable. Now even were I to allow that $u\,d\,x+v\,d\,y+w\,d\,z$ cannot, in the case of ordinary fluids, be an exact differential unless the motion is rectilinear, that would not be a fatal objection. For the equations of motion of fluids commonly employed are formed on the hypothesis that the mutual action of two elements of the fluid is normal to the surface which separates them, whereas one of the most remarkable properties of the æther with which we are acquainted, is the great tangential force which it is capable of exerting, in consequence of which the transversal vibrations which constitute light are propagated with such an immense velocity.

VI. *On the Solubility of Oxide of Lead in Pure Water.* *By* Lieut.-Col. Philip Yorke*.

IN the Philosophical Magazine for August 1834, I published a paper on the action of water and air on lead. Some of the principal results contained in it were confirmed by Bonsdorff in two papers; he found that 7000 parts of pure water free from access of carbonic acid dissolved one of oxide of lead; my experiments gave $\frac{1}{12,000}$th to $\frac{1}{10,000}$th. Since that time two papers have appeared on the same subject, one by Dr. Christison†, and one by Mr. R. Phillips, Jun.‡ The last-named chemist considers that the oxide of lead is not dissolved, but merely mechanically suspended in the water, because the liquid is deprived of the lead by passing it through

* Communicated by the Chemical Society; having been read May 17, 1845.

† Transactions of the Royal Society of Edinburgh.

‡ Chemical Gazette for Jan. 1, 1845.