value of π to 500 decimals and the date of its publication, was correct, as such value was compared with the author's given in Mr. Rutherford's paper of 1853, and of course agrees with what is given above in this.

IV. "On Double Refraction in a Viscous Fluid in motion." By J. Clerk Maxwell, M.A., Professor of Experimental Physics in the University of Cambridge. Received October 31, 1873.

According to Poisson's * theory of the internal friction of fluids, a viscous fluid behaves as an elastic solid would do if it were periodically liquefied for an instant and solidified again, so that at each fresh start it becomes for the moment like an elastic solid free from strain. The state of strain of certain transparent bodies may be investigated by means of their action on polarized light. This action was observed by Brewster, and was shown by Fresnel to be an instance of double refraction.

In 1866 I made some attempts to ascertain whether the state of strain in a viscous fluid in motion could be detected by its action on polarized light. I had a cylindrical box with a glass bottom. Within this box a solid cylinder could be made to rotate. The fluid to be examined was placed in the annular space between this cylinder and the sides of the box. Polarized light was thrown up through the fluid parallel to the axis, and the inner cylinder was then made to rotate. I was unable to obtain any result with solution of gum or sirup of sugar, though I observed an effect on polarized light when I compressed some Canada balsam which had become very thick and almost solid in a bottle.

It is easy, however, to observe the effect in Canada balsam, which is so fluid that it very rapidly assumes a level surface after being disturbed. Put some Canada balsam in a wide-mouthed square bottle; let light, polarized in a vertical plane, be transmitted through the fluid; observe the light through a Nicol's prism, and turn the prism so as to cut off the light; insert a spatula in the Canada balsam, in a vertical plane passing through the eye. Whenever the spatula is moved up or down in the fluid, the light reappears on both sides of the spatula; this continues only so long as the spatula is in motion. As soon as the motion stops, the light disappears, and that so quickly that I have hitherto been unable to determine the rate of relaxation of that state of strain which the light indicates.

If the motion of the spatula in its own plane, instead of being in the plane of polarization, is inclined 45° to it, no effect is observed, showing that the axes of strain are inclined 45° to the plane of shearing, as indicated by the theory.

I am not aware that this method of rendering visible the state of strain

* Journal de l'École Polytechnique, tome xiii. cah. xx. (1829).

of a viscous fluid has been hitherto employed; but it appears capable of furnishing important information as to the nature of viscosity in different substances.

Among transparent solids there is considerable diversity in their action on polarized light. If a small portion is cut from a piece of unannealed glass at a place where the strain is uniform, the effect on polarized light vanishes as soon as the glass is relieved from the stress caused by the unequal contraction of the parts surrounding it.

But if a plate of gelatine is allowed to dry under longitudinal tension, a small piece cut out of it exhibits the same effect on light as it did before, showing that a state of strain can exist without the action of stress. A film of gutta percha which has been stretched in one direction has a similar action on light. If a circular piece is cut out of such a stretched film and warmed, it contracts in the direction in which the stretching took place.

The body of a sea-nettle has all the appearance of a transparent jelly; and at one time I thought that the spontaneous contractions of the living animal might be rendered visible by means of polarized light transmitted through its body. But I found that even a very considerable pressure applied to the sides of the sea-nettle produced no effect on polarized light, and I thus found, what I might have learned by dissection, that the sea-nettle is not a true jelly, but consists of cells filled with fluid.

On the other hand, the crystalline lens of the eye, as Brewster observed, has a strong action on polarized light when strained either by external pressure or by the unequal contraction of its parts as it becomes dry.

I have enumerated these instances of the application of polarized light to the study of the structure of solid bodies as suggestions with respect to the application of the same method to liquids so as to determine whether a given liquid differs from a solid in having a very small "rigidity," or in having a small "time of relaxation"*, or in both ways. Those which, like Canada balsam, act strongly on polarized light, have probably a small "rigidity," but a sensible "time of relaxation." Those which do not show this action are probably much more "rigid," and owe their fluidity to the smallness of their "time of relaxation."

The Society then adjourned over the Christmas Recess to Thursday, January 8, 1874.

* The "time of relaxation" of a substance strained in a given manner is the time required for the complete relaxation of the strain, supposing the rate of relaxation to remain the same as at the beginning of this time.