5. "Researches tending to prove the Non-vascularity of certain Animal Tissues, and to demonstrate the peculiar uniform mode of their Organization and Nutrition." By Joseph Toynbee, Esq. Communicated by Sir Benjamin Brodie, Bart., F.R.S., &c.

The above was only in part read.

May 27, 1841.

SIR JOHN BARROW, Bart., V.P., in the Chair.

The Right Honourable the Earl of Carnarvon, and Ardaseer Cursetjee, Esq., were balloted for, and duly elected into the Society.

The following papers were read, viz.—

1. "On the Compensations of Polarized Light, with the description of a Polarimeter for Measuring Degrees of Polarization." By Sir David Brewster, K.H., D.C.L., F.R.S., and V.P.R.S. Ed.

In four papers published in the Philosophical Transactions for 1830, the author maintained, in opposition to the prevailing theory, that light either reflected or refracted at angles different from that at which it is completely polarized, does not consist of two portions, one completely polarized, and the other completely unpolarized, but that every portion of it has the same physical property, having approximated in an equal degree to the state of complete polarization. This conclusion, which had been derived from reasoning on the hypothesis that a pencil of light, composed of two pencils polarized respectively at angles of + and − 45° with the plane of reflexion, was equivalent to a pencil of common light, is confirmed in this paper by experiment, made with common light itself, reflected from different parts of the atmosphere, and from which the uniaxal or biaxal systems of rings were obtained. On placing such a system between light partially polarized in an opposite plane, the author found that the rings disappeared, the direct system being seen on one side of the plane of disappearance, and the complementary system on the other side. In this experiment the polarization of the light in one plane was compensated by the polarization of the same light in the opposite plane; and, consequently, both the pencils, which had undergone the two successive polarizing actions, had received the same degree of polarization in opposite planes; and in virtue of these two equal and opposite polarizations, the light at the point of compensation, where the system of rings disappeared, had been restored from partially polarized to common light; and the light on each side of this point of compensation was in opposite states of partial polarization.

In order to give a distinct view of the nature of this experiment, the author details the phenomena observed at particular angles of incidence on glass. From the results at an angle of incidence of 24°, the ray suffering one refraction at 80°, and a second reflexion

at $83\frac{1}{2}°$, he concludes that the compensation which takes place is produced neither by an equality of oppositely polarized rays, nor by a proportional admixture of common light, but by equal and opposite physical states of the whole pencil, whether reflected or refracted.

The remarkable phenomena produced at an angle of incidence on glass of 82° 44′ (at which angle $\cos(i + i') = \cos^2(i + i')$), led the author to the construction of what he terms *the compensating rhomb*, consisting of a well annealed rhomb of glass, or any other uncrystallized substance, having the angles of its base 130° 25′ and 46° 35′ respectively, when the index of refraction is 1·525. When a ray of light is incident upon the first surface at an angle of 82° 44′, exactly one-half of it is reflected; and the other half, after refraction, is reflected at the second surface, and emerges perpendicularly to the adjacent surface, without suffering refraction; each portion having, in the first instance, the same quantity of polarized light. The second portion is found, on examination, to be in the state of common light, although the ray at the second incidence consisted of more than one-half of polarized light. Hence if the pencil, previously to reflexion at the second surface, consist of 145 rays of polarized light, and 188 of common light, the effect of a single reflexion must be to depolarize polarized light, and to produce no change whatever upon common light, a property of a reflecting surface never yet recognized, and incompatible with all our present knowledge on the subject of the polarization of light.

The author then describes an instrument which he has invented for the purpose of accurately measuring the degrees of polarization, and which he therefore terms a *Polarimeter*. It consists of two parts; one of which is intended to produce a ray of compensation having a physical character susceptible of numerical expression, and the other to produce polarized bands, or rectilineal isochromatic lines, the extinction of which indicates that the compensation is effected. The construction and mode of operation of this instrument are, by the aid of figures, described and explained.

The following is the general law established by these researches; namely, that the compensations of polarized light are produced by equal and opposite rotations of the planes of polarization. Thus, when a ray of common light is incident, at any angle, upon the polished surface of a transparent body, the whole of the reflected pencil suffers a physical change, bringing it more or less into a state of complete polarization, in virtue of which change its planes of polarization are more or less turned into the plane of reflexion; while the whole of the refracted pencil has suffered a similar, but opposite change, in virtue of which its planes of polarization are turned more or less into a plane perpendicular to the plane of reflexion.

The author then enters into a theoretical investigation of the subject, and concludes by pointing out a few of the numerous applications of his theory.

2. Continuation of the paper of which the reading commenced