Thursday, March 14th, 1889.

J. J. WALKER, Esq., F.R.S., President, in the Chair.

Mr. C. E. Haselfoot, B.A., Fellow of Hertford College, Oxford, was elected a member, and Messrs. Roseveare and W. W. Taylor were admitted into the Society.

The following papers were read :—

Notes on Plane Curves, (iv.) Involution-condition of a Cubic and its Hessian ; (v.) Figure of a certain Cubic and its Hessian : the President (Mr. Elliott in the chair).

On Play "à outrance" : Major P. A. MacMahon, R.A.

Some Results in the Elementary Theory of Numbers : C. Loundesdorf, M.A.

The Characteristics of an Asymmetric Optical Combination : Dr. J. Larmor, M.A.

A new Angular and Trigonometrical Notation, with applications H. MacColl, M.A.

The following presents were received :—

"Proceedings of the Royal Society," Vol. XLV., Nos. 275 and 276.

"Educational Times," for March.

"Transactions of the Cambridge Philosophical Society," Vol. XIV., Part III.

"Transactions of the Royal Irish Academy," Vol. XXIX., Part V.

"The Collected Mathematical Papers of Arthur Cayley, Sc.D., F.R.S.," Vol. I.,* 4to ; Cambridge, 1889.

"Annals of Mathematics," Vol. IV., No. 4.

"Mémoires de la Société des Sciences Physiques et Naturelles de Bordeaux," Tome III., 20 Cahier, 1887.

"Bulletin de la Société Mathématique de France," Tome XVI., No. 6.

"Observations Pluviométriques et Thermométriques faites dans le Département de la Gironde de Juin, 1886, à Mai, 1887, Note de M. Rayet ;" 8vo pamphlet ; Bordeaux, 1887.

"Rendiconti del Circolo Matematico di Palermo," Tomo III., Fasc. 1, Jan., Feb., 1889.

"Beiblätter zu den Annalen der Physik und Chemie," Band XIII., Stück 2.

"Nieuw Archief voor Wiskunde," Deel XV., Stuk 2.

"Acta Mathematica," XII., 2.

"Rendiconti dell' Accademia delle Scienze Fisiche e Matematiche," Serie 2^o, Vol. II., Fasc. 1—12.

"Atti della Reale Accademia dei Lincei — Rendiconti," Vol. IV., Fasc. 10 ; Roma, 1888.

* The Society also subscribe for a copy of these papers.

"Vierteljahrsschrift der Naturforschenden Gesellschaft in Zürich," Vol. xxxiii., No. 2.

"Bollettino delle Pubblicazioni Italiane, ricevute per Diritto di Stampa," Nos. 75 and 76; Index to Ditto for 1888 (3 parts).

"The Planets upon Cardioides," by the Rev. G. T. Carruthers, M.A., Chaplain of Subatha, India.

"The Cause of Light," by the same.

"Supposed First Ascertainment of the Area of a Spherical Triangle by the Infinitesimal Analysis," by John Spare, M.A., M.D., New Bedford, Mass. (2 pp.).

The Characteristics of an Asymmetric Optical Combination.

By J. LARMOR.

[Read March 14th, 1889.]

1. The general properties of optical combinations which are symmetrical round an axis, such as ordinary telescopes and microscopes, have, as is well known, been analysed by Gauss; and the performance of these instruments, when aberrations are left out of account, has been shown to depend simply on three constants—which may be taken geometrically as the coordinates of the two principal points and the two principal foci, between whose mutual distances one linear relation exists.

It is now customary, and it conduces to clearness of view, to throw the theory into a geometrical form in the manner first completely set forth by Maxwell (*Quarterly Journal of Mathematics*, II, 1858). To effect this, without entering into details of the construction of the special instrument, we are confined to the use of only those properties that are *characteristic* of rays of light in general. For the purposes of the problem, when restricted to symmetry round the axis, these properties may be stated in the simple approximate form that (i) all rays proceeding from a point go to form the image of that point, (ii) for all such rays the time of passage from point to image ($\Sigma\mu ds$) is the same, because they belong to the same wave spreading out from the object point, and finally, after passing through the instrument, converging to the image. The application of the former of these principles requires that the rays are everywhere inclined at a small angle to the axis, as is usually the case in practice.