d'autres issues du corps, qu'on regarde comme impures et souillées" (Pierre Gonnerat, "Voyage aux Indes Orientales et à la Chine," à Paris, 1782, vol. i., p. 93).

KUMAGUSU MINAKATA.

Tanabe, Kii, Japan, December 13, 1913.

Systems of Rays on the Moon's Surface.

A GREAT deal has been said, and a great many theories have been put forward, as to the cause of these marvellous systems of rays on the surface of the moon. I now venture to put forward an explanation which has occurred to me, and should like the opinion of some of your readers upon it.

It is generally admitted that the volcanic action of the moon was of an enormous character, "even when the low force of lunar gravity is taken into consideration," and from our knowledge of the amount of lava emitted from one of our own small craters, we can conceive what a huge volume must have been thrown out from such gigantic craters as Clavius, Ptolemæus, or Copernicus. Now, from what we can see even to-day, the lunar surface is exceedingly mountainous, and I suggest that when these craters were in their full power huge volumes of lava were thrown out, and in many cases practically filled up valleys, or cañons between the mountains. We know the rays are from five to ten miles broad, even up to twenty miles, and from the action of the volcano there would always be the tendency for the lava to run away from the crater itself, thus forming these rays, like spokes from a hub. Some of the rays are, however, apparently of a prodigious length, up to 2000 miles long, but Prof. Pickering tells us that this length is an illusion, the long rays being made up of rays from different craters, which appear to form one long continuous ray, which satisfies the question of length.

Then many of these rays apparently run right across and almost obliterate (at full moon) such craters as Clavius and Maginnus. Now I think it is generally admitted that the ray systems from Tycho, Copernicus, and Kepler are the largest on the moon, and they are also three of the very largest craters. This points to the fact that they were the first eruptions on the lunar surface, and being the first, threw out the greatest volume of lava. This filled up the valleys in their neighbourhood, but afterwards other craters were erupted through the lava-covered rocks, though without breaking up the "lava valleys." It is highly probable that in these circumstances most, or all, the craters have their rays, though too small to be detected through even the largest glass. Their brilliance would, of course, be accounted for, by the sun shining directly upon them, through no atmosphere at all, or none worth mentioning. It seems, therefore, to me, that these rays must be geologically old remains of eruptions, dried up now, but still showing themselves on the lunar surface, though it is doubtful if the matter will ever be satisfactorily cleared up. C. HUBERT PLANT.

49 Lichfield Road, Walsall, December 16, 1913.

THE CAPE OBSERVATORY.¹

IN the preface to this work Sir David Gill relates that when, as a young astronomer, he was connected with Lord Crawford in the design and erection of the observatory at Dun Echt, he turned for assistance to Wilhelm Struve's "Description de l'Observatoire Astronomique Central

de Poulkova." Remembering the help and pleasure which Struve's work had given him, he resolved, in humble imitation, to write a description of the Cape Observatory.

"Struve," in the words of Gill, "had the true genius and spirit of the practical astronomer, the love of refined and precise methods of observation, and the inventive mechanical and engineering capacity."

Struve had the rare opportunity of building an observatory after his own heart, regardless of expense, which should fulfil the highest requirements of the astronomy of his time. Gill, animated by the same spirit as Struve, and with similar qualifications, greatly extended and remodelled an historic observatory. Thanks to his grasp of the trend of astronomy, his skill in the design and construction of instruments, and his administrative ability and energy, he left the Cape Observatory, at the close of his directorate, one of the best equipped and most efficient observatories in the world.

The volume, as its title indicates, is divided into two parts. The first consists of a history of the observatory from its foundation to the present time, with brief biographical notices of those who have filled the position of H.M. Astronomer, and an appreciative criticism of their work and their contribution to the development of the observatory. Following this is a brief account of the past and present instrumental equipment, and a comprehensive survey of the important astronomical and geodetic results which have proceeded from the Cape Observatory. The second part of the book is devoted to a detailed description, illustrated by many photographs and diagrams, of the important instruments which have been erected at the observatory during Sir David Gill's directorate.

The value of the Cape as a site for the extension of astronomy and geodesy to the southern hemisphere was first appreciated by Lacaille, who in a brief visit in the middle of the eighteenth century made observations of the positions of more than 10,000 stars, and measured an arc of the meridian.

After the British occupation, the establishment of a permanent observatory at the Cape was considered by the Board of Longitude in February, 1820; the appointment of an astronomer was recommended, and estimates were obtained from Troughton, Dollond, and Jones for suitable equipment. The Board of Admiralty expressed its concurrence with this proposal, and the observatory was established by Order in Council on October 20, 1820, the staff to consist of one astronomer, one assistant, and one labourer.

The Rev. Fearon Fallows, fellow of St. John's College, Cambridge, was appointed H.M. Astronomer, and directed to make observations so far as possible similar to and complementary to those at Greenwich. He fixed the site of the observatory on part of a bare, rocky hill, covered with thistles and infested with snakes, but tolerably free from the sandy dust prevalent near Cape Town, and commanding a good view of Table

¹ "A History and Description of the Royal Observatory, Cape of Good Hope." By Sir David Gill K.C.B. F.R.S. Pp. cxc+136+plates. (London: H.M. Stationery Office, 1913.)