MEMOIRS

OF THE

BRITISH ASTRONOMICAL

ASSOCIATION

Who's Who in the Moon

NOTES ON THE NAMES OF ALL LUNAR FORMATIONS ADOPTED IN 1935 BY THE INTERNATIONAL ASTRONOMICAL UNION

HISTORICAL SECTION

DIRECTOR, MRS JOHN EVERSHED

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Who's Who in the Moon

FIRST MEMOIR OF THE HISTORICAL SECTION

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INTRODUCTION

THE NAMING OF LUNAR FORMATIONS

The first to give names to the markings seen on the Moon's "spotty globe" was Langrenus of Brussels, whose map was published in 1645. A preliminary pen-and-ink sketch of this, found at Brussels, gives the name of his patron Philip IV of Spain to the largest "ocean" (our Oceanus Procellarum), the name of Anna to the most conspicuous crater (our Tycho), and several names of princes and princesses to other features: all the rest are contemporary astronomers, such as Galileo, Lansberg, Bullialdus, Sempilius; and the sea at the top of the map (north) is marked Mare Astronomorum, or Sea of Astronomers (our Mare Frigoris). This sketch (reproduced in *Ciel et Terre*, xxix, 99) has 48 names only, but a Paris copy of the map has over 300.

Next Hevelius of Danzig, in 1647, published his *Selenographia*, but he called the lunar features shown on his maps after terrestrial seas and continents, capes, islands, and mountains, which they more or less resemble in form and in relative positions. Thus our Mare Serenitatis and Tranquillitatis figure together as Pontus Euxinus (Black Sea), with our Mare Crisium as Palus Maeotis (Sea of Azov), and with Mts Caucasus and Haemus (Balkan Mts) in the near neighbourhood.

Then, shortly after this, appeared the work which was to eclipse them both and become the foundation of our present lunar nomenclature, retaining, however, something from each of its forerunners. Riccioli of Bologna, in his *Almagestum Novum*, published in 1651, printed a map of the Full Moon (without names) drawn by Grimaldi, and a similar map with every feature named by himself. He followed Hevelius in calling lunar mountains after terrestrial; but though he still called the extensive dark areas seas, he gave to them names drawn from the various influences which the Moon was popularly supposed to have upon Earth, the western regions seen in her early phases having mostly beneficent suggestions of clear calm weather, while on the eastern side storms and rain predominate. With the craters, however, he followed the lead of Langrenus, naming them after astronomers and other learned men; and he retained many of the same names, though not always giving them to the same formations. The names from living members of the Spanish and Austrian dynasty were not suitable for international use; but Riccioli developed the system of Langrenus by including ancient and mediæval astronomers as well as contemporaries; and he explains that the ancient are placed at the top (north) of his map, the moderns below, also that he has placed near together those who were alike in their studies or their

epoch. Thus in the north we find Plato with friends and pupils gathered round him, and in the south Tycho similarly accompanied by his disciples. And as Riccioli himself was a consistent follower of Tycho, and supported his planetary system against that of Copernicus, he gave to Tycho a most commanding position, and tells us that he flung the earth-movers into the Ocean of Storms, like floating islands! Nevertheless, he admired Copernicus, and we note that to him is given one of the most splendid of craters, and to Aristarchus the brightest.

Riccioli's nomenclature, then, was a consistent scheme, the mountains, seas, and craters falling into three distinct classes, terrestrial, symbolical, and personal; and the personal names are so grouped as to represent graphically the history of astronomy. Later selenographers have in general followed the division of the three classes, but the historical arrangement has been obliterated.

Nearly a century and a half after the work of these three came Schröter, who, observing with larger and better instruments than theirs, added many more names, some ancient and some belonging to his own time: also he introduced the use of Greek and Roman letters for the lesser formations. His *Selenotopographische Fragmente*, in two volumes, was published in 1791 and 1802. Lohrmann added a few names of contemporaries in his *Topographie der Sichtbaren Mondoberfläche*, the first part of which appeared in 1824.

Then came the epoch-making work of Beer and Mädler in 1837, *Der Mond*, with its three-foot *Mappa Selenographica* containing 427 names. Over 200 of these were taken from Riccioli, 60 from Schröter, and 145 more were added by Mädler, including a large number of geographers, explorers, and navigators, who increased our knowledge of our own planet.

Neison's *The Moon*, published in 1876, is essentially a revision of Beer and Mädler, with many additions from his own numerous observations and drawings, and from those of Schröter and others. To Beer and Mädler's names he added a few of the older names which had been omitted because they could not be identified, 67 from the *British Association Catalogue* chiefly due to Birt and Lee, and 14 new names of well-known astronomers and mathematicians, especially selenographers. Altogether Neison included 513 names, and gave the authority for each.

Two years later, Schmidt of Athens published his six-foot map, adding more than 50 names (some of which unfortunately clashed with those of the British Association and Neison).

Since this date many excellent maps have been and are being constructed, which need not be enumerated here, especially as the authors are all represented on the Moon and therefore appear (like those already mentioned) in the following pages, with notes on their life and work. Riccioli secured a large walled plain for Grimaldi, his honoured friend and author of his lunar map, and gave his own name to a smaller formation close beside it (*see* Map). Later

selenographers chose sites for one another,* and also added other new names, many of which have not been generally adopted, and so it was realized early in this century that to avoid hopeless confusion a standard map and catalogue ought to be drawn up internationally. The first step was Miss Blagg's *Collated List of Lunar Formations named or lettered in the Maps of Neison, Schmidt, and Mädler*, which was compiled for a special committee of the International Association of Academies, and published in 1913; and this was followed by the work of the Lunar Commission of the International Astronomical Union, resulting in 1935 in the publication of *Named Lunar Formations: Catalogue and Map*, by Mary Blagg and K. Müller. Besides the names from the Collated List, a selection of others more recently given was added, bringing up the total to 672, of which 609 are personal names.

Here then we have an authoritative list, which must be consulted in any subsequent work.

THE OBJECT OF THIS MEMOIR

Fortunately, *Named Lunar Formations* was nearing completion when this Section undertook to compile the present Memoir, and our obvious course was to take it as our standard, using all the names therein adopted and no others.

A discussion concerning Cichus at B.A.A. meetings had shown how puzzling are the familiar names of many lunar features when one asks who are the persons represented and what they did to merit a place in the Moon. To supply miniature biographies of all seemed a suitable piece of team-work for the Historical Section, and we now present our *Who's Who in the Moon*, hoping it will be welcome to astronomers, especially lunar observers.

Something on the same lines has been done before. A catalogue by Jackson and others in the old *Astronomical Register* for the years 1876–1879 contains explanations of many names, the latest being those given by Neison; Brochmann's list in the *Nordisk Astronomisk Tidsskrift*, 1920–1921, which was translated by Henselig into German and published by the Bund der Sternfreunde, includes also names adopted or added by Schmidt; Fauth's list in *Unser Mond* is evidently based on Brochmann's, but extended to agree with *Named Lunar Formations*.

But these works give only very brief notes; some names receive no explanation at all, and some are wrongly identified. They have been very helpful in our search, but we aimed at something more comprehensive, and in many doubtful cases we have been able to establish identity by consulting the writings of those who gave the names. Riccioli's *Almagestum Novum* is indispensable for this, for he almost always gives some clue to his names, in his list of lunar

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* Brenner chose one for himself, but his name is now applied to a different formation.

features, chronicle of learned men, or notes scattered in the text; and Mädler, Schröter, Birt, and Krieger often give indications of the persons they intended to commemorate. Many names, however, are *not* explained; the givers having apparently forgotten that persons well known in their time might not be so in ours, or might easily be confused with others of the same name. Added to this, names are often disguised by their Latinized form, so much used in former days, or misspelt either by the original giver or in the course of repetition by later selenographers. Instances of all these difficulties and their suggested solutions may be found in the following pages.

It is inevitable also that to some of the great names, because given late, only insignificant formations could be allotted, or else positions—like Newton's—so near to the limb that they might almost as well be on the invisible side of the Moon, while conspicuous craters often bear obscure or forgotten names.

An historical and often romantic interest, however, attaches to the obscure and forgotten names, and to track them down has been a lesson in astronomical history, and sometimes quite an exciting chase! More space has sometimes been given to them than to the famous names, because the information is otherwise difficult to procure: everyone knows who was Kepler or Copernicus, but how many can say who was Billy or Bettinus, Stiborius or Sirsalis? Yet these did good work for astronomy, each in his own way.

For the sake of completeness, we have included in our list all the non-personal names, of seas, capes, and mountains, which are adopted in *Named Lunar Formations*, with explanations when required.

TWO LUNAR MAPS

It will be found interesting to compare our two maps, for they bear witness to the progress made in three centuries in studying and naming the features seen on the Moon. Riccioli's was the foundation of lunar nomenclature; Mr Patston's contains all the objects named in our latest standard work, *Named Lunar Formations*.

Riccioli's map has been photographed for us, by kind permission of the Royal Astronomical Society, from his *Almagestum Novum* in the Library. According to custom in his day, north is at the top. It will be noted that some of his names have been dropped (usually because of difficulty in identification), and some have been transferred to other formations.

Mr Patston's key-map is based on one kindly sent to us by the author, Dr Karl Müller, which forms a transparent key-map, with names, to a reduced copy of Debes' Lunar Map, and was published in *Der Grosse Brockhaus, Handbuch des Wissens*, Brockhaus, Leipzig. Our work includes, however, a great many more names than this, and Mr Patston has drawn the additional formations from *Named Lunar Formations*, and also made other changes to suit our purpose. The formations are numbered, and the numbers belonging

to seas (mare, lacus, palus, or sinus) are enclosed in brackets. The larger seas bear their names as well as the bracketed numbers; the smaller seas and the mountains are given name *or* number according to the exigencies of space. All craters and walled plains have numbers only. Any object included in this Memoir can easily be found on the map by referring to the number and map co-ordinates which are at the end of the explanatory note following each name in the text: when a number is omitted, the name will be found on the map.

CONTRIBUTORS TO THE MEMOIR

The compilers of this *Who's Who* are nearly all members of the B.A.A., and contributions have come not only from the British Isles, but also from Austria, Belgium, Czechoslovakia, Denmark, France, Holland, Italy, and the United States of America. Most of the names were found in encyclopædias or histories; but when details were difficult to obtain, or identification was doubtful, valuable help was given by such experts in astronomical history and literature as Mr T. L. MacDonald, director of the Lunar Section, Dr Karl Müller of Vienna, Mag. F. Fischer of Prague, and Professor Pio Emanuelli of Rome. Dr Felix de Roy sent detailed notes on early astronomers of the Netherlands, and Mynheer Axel Nielsen on some Scandinavians. We should like to thank also Miss Williams and Miss Wadsworth of the R.A.S. and the staff of the London Library for information supplied and books sent. The B.A.A. Library has of course been extremely useful.

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LIST OF AUTHORITIES FOR THE NAMES OF LUNAR FORMATIONS

The names are all those adopted by the International Astronomical Union in *Named Lunar Formations*. Letters in brackets following each name signify the authority for that name; they are as follows, with the abbreviations here used:

B = Birt.	Lee.
Blagg.	Lam = Lamèch.
Com = Commission, I.A.U.	Lo = Lohrmann.
Deb = Debes.	M = Mädler.
Elger.	Mül = Müller.
Fauth.	N = Neison.
Frz = Franz.	Peu = Peucker.
Gaud = Gaudibert.	R = Riccioli.
Gru = Gruitheisen.	Schr = Schröter.
Hell.	Smt = Schmidt.
Hev = Hevelius.	Webb.
Kön = König.	Wil = Wilkins.
Kr = Krieger.	

Other abbreviations are:

B.A.A. = British Astronomical Association.
I.A.U. = International Astronomical Union.
N.L.F. = *Named Lunar Formations*.
R.A.S. = Royal Astronomical Society.
Fl.   = Flourished.

NAMES OF LUNAR FORMATIONS

WITH BIOGRAPHICAL AND EXPLANATORY NOTES

Letters in brackets following a name indicate the authority for that name: number and letters following the explanatory note indicate its number and co-ordinates on the key-map. (When the number is omitted, the name will be found on the map.)

ABENEZRA. Abraham bar Rabbi ben Ezra, *c.* 1092–1167. **(R)**

A distinguished Jewish scholar, whose writings on arithmetic and astronomy are valued by historians of science. He was also a philosopher and commentator on the Old Testament, and his hymns are still sung in synagogues. He was born in Toledo, then a great centre of learning, but travelled for many years in Egypt, Italy, and France, visited England, and died in Rome. He is the "Rabbi ben Ezra" of Browning's well-known poem. **1 DE g**

ABULFEDA. Ismail Abu'l-Fida, 1273–1331. **(R)**

One of the last great geographers of the Arab school which had been founded by Almamun in Baghdad. He was a Syrian prince, born in Damascus, descended from the father of Saladin: from his twelfth year he was constantly engaged in wars, yet he wrote an encyclopædic work on geography, which summarized and extended the work of his predecessors and contained many original determinations of latitude and longitude. He was also historian and astronomer. **2 D g**

ACHERUSIA (Prom.) (Hev)

Ancient name of a promontory on the south coast of the Pontus Euxinus (Black Sea), which in Hevelius' Map represented our Maria Serenitatis and Tranquillitatis. **3 D d**

ADAMS. John Couch Adams, 1819–1892. **(B)**

Born at Lidcot Farmhouse in Cornwall. He is renowned for his discovery of the planet Neptune from calculations of the perturbations of Uranus, independently of Leverrier; also for his work on the lunar acceleration, the orbit of the Leonid meteors, and other brilliant investigations. In 1851 he became President of the R.A.S., and in 1860 Director of Cambridge Observatory, where he resided until his death. **4 B h**

AENARIUM (Prom.) (Hev)

Misspelt by Tobias Mayer and Mädler for Taenarium, old name of Cape Matapan, in Peloponnesus. (*See* Hevelius, *Selenographia*, p. 235.) **5 F g**

AESTATIS, Mare. Summer Sea. (Frz) **K g**

AESTUUM, Sinus. Bay of Billows. (R) **7 F de**

AGARUM (Prom.). (Hev)

Old name of a promontory on the Maeotis Palus (Sea of Azov) of Hevelius, our Mare Crisium. **8 A d**

AGASSIZ. Louis Jean Rodolphe Agassiz, 1807–1873. (Smt)

Swiss naturalist. He was doctor of philosophy at Erlangen and of medicine at Munich, then professor of zoology and geology at Harvard, U.S.A., where he won fame by his Lowell Lectures, and founded a museum of comparative zoology (1858). He wrote on the *Fishes of Central Europe, A Journey in Brazil,* and the *Natural History of the U.S.A.* **9 E b**

AGATHARCHIDES. Late second century B.C. (M)

Greek geographer and historian, born at Cnidos, lived in Alexandria. He wrote three books, on Asia, Europe, and the Erythraean Sea, including in the latter not only the Red Sea proper, but all the ocean between Africa and India and the Persian Gulf. He recorded in detail all the Greeks knew of these regions in his time: interesting fragments of the last work only are extant. **10 H g**

AGRIPPA. Fl. A.D. 92. (R)

Nothing seems to be known of this astronomer except that he observed in Bithynia in A.D. 92 an occultation of the Pleiades by the Moon, and determined the longitudes of some other stars. These observations were made use of by Ptolemy in his *Almagest.* **11 E e**

AIRY. George Biddell Airy, 1801–1892. (M)

Born at Alnwick, Northumberland, passed brilliantly through Cambridge University, and was appointed Plumian professor in charge of the new observatory there. In 1835 he became Astronomer Royal at Greenwich Observatory, created the departments of magnetism and meteorology, solar photography and spectroscopy, and published all the planetary and lunar observations made there since 1760. He resigned in 1881 to devote himself more fully to his work on the lunar theory. **12 E g**

ALBATEGNIUS. (Known also as Albattani.) Muhammed ben Geber al Batani, *c.* 850–929. (R)

Arab prince and astronomer, born at Batan in Mesopotamia, observed at Aracte, Antioch, and Baghdad. Comparing his observations with those of Ptolemy, he discovered the movement of the Sun's apogee and the varying obliquity of the ecliptic, and found a more accurate value for precession of the equinoxes. In trigonometry he introduced the use of sines. His *Movements of the Stars,* in a Latin

translation, enabled Hevelius to discover the secular variation in the Moon's motion.   **13 E fg**

ALEXANDER.   Alexander the Great, of Macedon.   356–323 B.C.   (B)

His conquering expeditions made East and West known to one another, and widened the scope of Greek learning in geography, natural history, and other directions; and his city of Alexandria in Egypt became a scientific centre.   Birt simply says he gave the name because of the resemblance of the object to that named Julius Caesar (*Memoir on the Mare Serenitatis*, 1869, p. 12).   **14 E b**

ALFRAGANUS.   Muhammed ebn Ketir al Fargani, *c.* 840.   (R)

Arab astronomer, named from his home, Ferghana, in Central Asia.   Author of *Elements of Astronomy and Chronology*, in which he follows Ptolemy closely, but sometimes substitutes more accurate figures "determined by Almamun of glorious memory" and his astronomers.   He also adds some of their illusory speculations.   The book was translated into Latin in the twelfth century, and contributed to the revival of science in Europe.   From it Dante took most of his astronomical data.   **15 D f**

ALHAZEN.   Abu Ali al-Hasan, 987–1038.   (M)

Arab mathematician, born in Basra, patronized by Caliph Hakem, in Cairo, where he made his observations and wrote his book on *Optics*.   This was the first important work on the subject since the time of Ptolemy, and contained more accurate values of astronomical refraction.   It was printed at Basle in 1572, and served as foundation for Kepler's treatise.   He also wrote commentaries on Euclid and Ptolemy's *Almagest*.   **16 A d**

ALIACENSIS.   Pierre d'Ailly, 1350–1420.   (R)

French theologian and geographer, Bishop of Cambrai and Cardinal Legate for Germany under Pope John XXII.   He urged the reformation of the calendar, and wrote on astronomy.   His *Imago Mundi* contained the geographical knowledge of his age; and a passage (copied almost literally from Roger Bacon) stating that the ocean between western Europe and eastern Asia cannot be very wide was quoted by Columbus in favour of his expedition.   **17 E h**

ALMANON.   Abdalla Al Mamun, *d.* 833.   (R)

Caliph of Baghdad, son of Harun al Raschid.   He was a great patron of science, collecting and having translated into Arabic many Greek and Persian works, and building a fine observatory in 829. Here continuous observations were carried on, with instruments similar to the Greek, but larger and of better workmanship.   An arc of meridian was measured to test Ptolemy's estimate of the size of the

Earth, and the obliquity of the ecliptic was determined afresh as 23° 33′.   **18 D g**

Riccioli's original spelling, Al Mamon, was more correct, and must have been altered by some later selenographer.

ALPETRAGIUS.   Nur ed-din al Betrugi, twelfth century.   (R)

Arab astronomer, born in Morocco, lived in Seville.   In his *Physical Theory of the Planets* he attempted to improve upon the complicated Ptolemaic system, but with small success, although his book attracted a good deal of attention.   It was translated into Hebrew in the thirteenth century and from that into Latin, and published in Venice in 1531.   **19 F g**

ALPHONSUS.   Alfonso X, 1223–1284.   (R)

King of Castile, surnamed "el Sabio" (the Learned).   He assembled at Toledo Christian, Jewish, and Moslem astronomers, to draw up the *Alphonsine Tables*.   These were published on the day of his accession in 1252: they superseded Arzachel's *Toletan Tables*, and for 300 years were the standard authority throughout Europe.   They contained data for planetary positions and forthcoming eclipses, for regulating the ecclesiastical calendar, casting horoscopes, etc.: some of the constants, notably the length of the year, were more accurate than any published earlier.   He also published the *Libros de Saber*, an astronomical encyclopædia, compiled chiefly from Arab sources. **20 F g**

ALPINE VALLEY.   (Schr)   **21 E b**

ALPS (Mts).   (Hev)   **22 E b**

ALTAI (Mts).   (M)   **23 CD h**

AMPÈRE.   André Marie Ampère, 1775–1836.   (Smt)

Born at Lyons, lectured and wrote on many subjects, until in 1809 he became professor of analysis at the Polytechnic School in Paris, and devoted himself almost entirely to science.   Famous for his discovery of the relations between magnetism and electricity, and development of electro-dynamics.   The unit of electric current is called by his name.   In infancy he is said to have worked out sums with pebbles before he knew figures.   **24 F d**

ANAXAGORAS.   500–428 B.C.   (R)

Born at Clazomenae, in Ionia.   Taught in Athens that the first cause of the Universe is Nous (Mind); that the Sun is a blazing mass "larger than Peloponnesus"; that the Moon receives light from him and resembles Earth, with plains, mountains, and valleys; that lunar eclipses are caused by Earth's shadow.   For his views he was banished, but escaped death through the influence of his friend and pupil, Pericles.   **25 F a**

ANAXIMANDER. *c.* 611–*c.* 547 B.C. (R)

Greek philosopher, a younger contemporary of Thales, and like him a native of Miletus. In his theory of the Universe, Heaven was a sphere, and Earth a short, broad cylinder suspended freely at its centre. He is said to have made the first Greek map of the world, and a celestial globe, and to have introduced the gnomon into Greece, observing with it solstices and equinoxes. **26 G a**

ANAXIMENES. 585–528 B.C. (R)

Greek philosopher of Miletus, like the above. He considered Earth to be flat, resting on air; the Sun also flat "like a leaf," and hot because of its rapid motion round Earth. The stars he believed to be much farther away, too far for us to feel their heat, and fastened "like nails" on a crystal sphere, an idea which persisted until Copernicus. **27 F G a**

ANDĚL. Karel Andĕl, 1884–   . (Mül)

Czech schoolmaster and astronomer, born at Modrany, near Prague. He has published star maps, and maps and photographs of the Moon, also a book on the Moon in 1928. His *Mappa Selenographica* (Prague, 1926) is skilfully drawn and contains much fine detail. **28 D f**

ÅNGSTRÖM. Anders Jonas Ångström, 1814–1874. (Kr)

Swedish physicist, educated at Uppsala University, where he afterwards became professor of physics. He made extensive researches on heat, magnetism, optics, and spectroscopy, and was the first to examine the spectrum of the Aurora Borealis and detect and measure the characteristic bright line in its yellow-green region. His *Recherches sur le Spectre Solaire* forms a supplement to Kirchhoff's theories; and his map of solar spectrum wave-lengths was for long the universal standard of reference in spectroscopy. The "Angstrom unit" was named in his honour. **29 H c**

ANGUIS, Mare. Serpent Sea. A narrow, winding plain. (Frz) **30 A cd**

ANSGARIUS. Saint Ansgar, 801–864. (M)

Born in Picardy. He was the first Bishop of Hamburg, and in 847 Archbishop of Bremen. For thirty-four years he travelled in Sweden, Denmark, and all the south Baltic lands, introducing Christianity there and bringing the knowledge of these scarcely known countries to western Europe. **31 A g**

APENNINES, Mts. (Hev) **EF cd**

APIANUS (or Apian). Peter Bienewitz, 1495–1552. (R)

Born in Leisnig (Saxony), became professor of mathematics in Ingolstadt; wrote on cosmography and made a map of the world, showing the newly discovered lands in America. His *Astronomicum*

Caesareum, dedicated to the Emperor Charles V, contains a star map and ingenious revolving discs for determining positions of heavenly bodies, elements of lunar eclipses, etc. He observed five comets and discovered that the tails point always away from the Sun; and his observations of the 1531 comet enabled Halley to identify it with those of 1607 and 1682 and predict its return. The Biene of his native name, meaning a bee, suggested the Latin form (*apis* = a bee). **33 A h**

APOLLONIUS. Latter half of third century B.C. (M)

One of the greatest mathematicians of antiquity. His treatise on *Conics* gained for him the title of the Great Geometer. He was born in Perga (Asia Minor), but lived in Alexandria, and Ptolemy quotes him as one of the originators of the system of epicycles and excentrics to represent the movements of Sun, Moon, and planets, in place of the spheres of Eudoxus and Aristotle. **34 A e**

ARAGO. Dominique François Jean Arago, 1786–1853. (M)

Born and educated at Perpignan, and was appointed professor of geometry and astronomer at Paris Observatory when only twenty-three years old. He lectured on astronomy, investigated the polarization of light, and made many discoveries in optics and magnetism. **35 D e**

ARATUS. *c.* 315–*c.* 245 B.C. (R)

Greek poet, born at Soli in Asia Minor, and invited to the Court of Antigonus of Macedonia. Here he wrote *The Phaenomena*, a poetical paraphrase of a lost work by Eudoxus, containing the oldest description we possess of the forty-eight ancient constellations, whose origin was obscure even then. It has been immensely popular: Hipparchus wrote a commentary on it, Cicero translated it into Latin. St Paul, a fellow-countryman of the poet, quoted from it in his speech on Mars' Hill. Historically it is of great value. **36 E cd**

ARCHIMEDES. *c.* 287–212 B.C. (R)

Greek mathematician and physicist, born in Syracuse, studied in Alexandria, then returned to Sicily. He discovered the hydrostatic principle which bears his name, and the principle of the lever, invented the water-screw and many other mechanical contrivances. At the capture of Syracuse by the Romans he was killed by a soldier. **37 F c**

ARCHYTAS. *c.* 428–347 B.C. (R)

Greek philosopher, general, statesman, and geometer of remarkable ability, "a measurer of earth and sea" according to Horace. He made machines and automatons, including a famous wooden dove that would fly. He was born at Tarentum, and was head of the Pythagorean school in Italy when Plato visited him and became his intimate friend. He was drowned on a voyage across the Adriatic. **38 E a**

ARGAEUS, Mt. (Webb)

Ancient name of a mountain in Cappadocia. **39 C d**

ARGELANDER. Friedrich Wilhelm August Argelander, 1799–1875. (B)

Born at Memel, he became Bessel's pupil and chief assistant at Königsberg, 1821–1823, then after appointments at Abö and Helsingfors was Director of Bonn Observatory for nearly half a century. Here he completed his *Star Atlas* and the *Bonn Durchmusterung*, forming a survey of the northern heavens which includes over 300,000 stars. His system of observing variable stars by the visual "step" method was everywhere adopted. **40 E g**

ARIADAEUS. Arrhidaeus, *d.* 317 B.C. (R)

Son of Philip of Macedon, crowned king in Babylon under the name of Philip when Alexander the Great his half-brother died there, assassinated six years later. His only claim to a place among the learned is the legendary letter of Dionysius the Areopagite, which describes the miraculous darkness during the Crucifixion, and adds that by consulting the "*Regula*," or Canon, of "Philippus Aridaeus" he knew it could not be caused by an eclipse. The letter was an invention, published by a ninth-century monk, but a Canon of Eclipses may have been compiled from Babylonian records and predictions, and dedicated to Arrhidaeus as king, especially as Aristotle exhorted the astronomer Callisthenes to collect such records when with Alexander. Riccioli quotes the letter as genuine (*Almagestum Novum*, i, 358), and places Dionysius and Arrhidaeus (slightly misspelt) together on the Moon. An Era of Philippus Arrhidaeus was used in chronology beginning with the death of Alexander, 323 B.C. (*See* "Regula Philippi Arrhidaei," by F. Cumont, *Isis*, xxvi, 8–12.) **41 D e**

ARISTARCHUS. *c.* 310–*c.* 230 B.C. (R)

Greek astronomer, of Samos. He was the first to maintain that the Earth moves round the Sun as well as turns on her axis, thus anticipating the system of Copernicus. He attempted to measure the relative distances of Sun and Moon by observing their angular distance at the moment of dichotomy. **42 J cd**

ARISTILLUS, *c.* 280 B.C. (R).

One of the earliest astronomers of the Greek school of Alexandria. With Timocharis he measured and recorded positions of stars on the celestial sphere, and made observations of Sun and planets, which were useful to their successors. **43 E c**

ARISTOTELES. Aristotle, 383–322 B.C. (R)

Greek philosopher, whose influence was paramount in Europe for many centuries. He was born at Stagira, in Macedonia, was tutor to Alexander the Great, and later taught in Athens. He advanced almost every branch of knowledge studied in his time, and systematized the astronomy, adopting and developing Eudoxus' theory of concentric spheres. **44 E b**

ARNOLD.   Christoph Arnold, 1650–1695.   (Schr)

German peasant of Sommerfeld, near Leipzig, who was a keen amateur astronomer and discovered the comet of 1682 some days before Hevelius.   (When it reappeared in 1758, according to Halley's prediction, it was again first seen by an amateur—*see* PALITZSCH.) Arnold also saw and recorded the transit of Mercury in 1690, and received for this a reward from a Leipzig magistrate.   **45 D a**

Schröter expressly mentions the name Christoph, so the identity is not in doubt.

ARZACHEL.   Al Zarkala, *c.* 1028–1087.   (R)

A Spanish-Arab astronomer, who constructed the Tables of Toledo, where he probably lived; but very little is known about him, though his Tables were widely known and much used.   His obliquity of the ecliptic is accurate within one minute of arc.   He wrote also on the astrolabe.   **46 F g**

ASCLEPI.   Giuseppe Asclepi, 1706–1776.   (Smt)

One of the Jesuit astronomers at the Collegio Romano from 1759, when observations were made from the palace roof, before the observatory was built.   He wrote on the transit of Venus in 1761, the solar eclipse of 1764, aberration of light, movements of comets, and problems in physics.   When his Order was suppressed, in 1773, he retired to Macerata (Italy), his birthplace, but returned next year to Rome and lived there quietly as a priest till his death.   **47 D k**

ATLAS.   (R)

In Greek fable, one of the Titans standing at the western end of the inhabited earth and supporting the heavens on his shoulder, as represented in the Farnese statue now in Naples Museum.   Riccioli believed the original of the legend was a king of Morocco learned in astronomy who lived about 1580 B.C.   **48 C b**

AUSTRALE, Mare.   Southern Sea.   (M)

Close to the S.W. lunar limb.   **BC jk**

AUTOLYCUS.   *c.* 330 B.C.   (R)

Greek astronomer of Pitane, in Asia Minor.   Author of the oldest extant treatise on astronomy, *The Moving Sphere,* which explains on simple geometrical principles the familiar apparent movements of the heavenly bodies.   He also wrote on *The Risings and Settings of Stars.*   **50 E c**

AUTUMNI, Mare.   Autumn Sea.   (Frz)   K fg

AUWERS.   Georg Friedrich Julius Arthur Auwers, 1838–1915.   (Kr)

Born at Göttingen.   He discovered Nova Scorpionis in 1860, conducted expeditions to observe transits of Venus in 1874 and 1882,

and became Director of Potsdam Observatory in 1881. His name is linked with that of Sir David Gill in determinations of the solar parallax, but is probably best known for his published fundamental reductions of valuable earlier star catalogues. **52 D d**

AZOPHI. Abderrahman Al-Sufi, 903–986. (R)

Persian astronomer, famous for his star catalogue, in which the magnitudes were so carefully determined that it is often compared with Ptolemy's and with modern catalogues to investigate possible changes in stellar brightness. His *Book of Fixed Stars* contains also some of the earliest known star maps, with figures of the constellations. Al-Sufi was friend and teacher to one of the Persian princes of Baghdad who in the tenth century revived the earlier school of astronomy founded by the Arab Caliphs. **53 DE g**

AZOUT. Adrien Auzout, 1622–1691. (Schr)

French astronomer and physicist, son of a judge's clerk in Rouen. He was instrumental in founding the Académie des Sciences, and in persuading Louis XIV to build and equip Paris Observatory; made many astronomical observations there, and invented the filar micrometer. (Gascoigne's prior invention was only known later.) In 1682 he visited England and was elected a Fellow of the Royal Society. **54 A e**

BABBAGE. Charles Babbage, 1792–1871. (B)

The inventor of an analytical calculating machine. He was born at Teignmouth, and as an undergraduate at Cambridge joined John Herschel and Peacock in founding the Analytical Society and introducing into England the notation of the differential calculus. He was one of the founders of the Royal Astronomical Society. **55 H a**

BACO. Roger Bacon, 1214–1294. (M)

A great pioneer in science, he wrote on many branches of learning, and opposed the excessive reverence for authority (especially Aristotle's) of his day, insisting that observation and experiment are essential to knowledge. As he was a Franciscan friar, this led to conflict with his Order. When discussing optics in his *Opus Majus* he says that refracting lenses can make distant objects look near, and that this might be applied to Sun and stars. He was born near Ilchester (Somerset), and studied in Oxford and Paris. **56 DE j**

Mädler intended to honour the above, for he speaks of him in his *History of Astronomy* with the greatest admiration, and rather slightingly of Francis Bacon.

BAILLAUD. Benjamin Baillaud, 1848–1934. (Lam)

Born at Châlon-sur-Saône; was assistant in Paris Observatory; then Director of Toulouse Observatory and doyen of the Faculty of Sciences in the University. He infused new life into both: new instruments and important new departments were established in the

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Observatory; new professorships, new buildings, and well-appointed laboratories in the University. From 1907 he was Director of Paris Observatory, and presided successively over the permanent committee of the Carte du Ciel, the Bureau International de l'Heure, and the International Astronomical Union. **57 E a**

BAILLY. Jean Sylvain Bailly, 1736–1793. (Schr)

Chiefly known by his *Histoire d'Astronomie* and his tragic political career. Having studied under Lacaille, he computed cometary orbits and the perturbations of Jupiter's satellites, using Clairaut's lunar theory for these; and in 1771 planned observations for measuring their variations in brightness. Then the Revolution swept him away like a torrent, as he wrote to Lalande; he became President of the National Assembly and Mayor of Paris, but in the end he was condemned and executed. **58 G k**

BAILY. Francis Baily, 1774–1844. (M)

A successful English stockbroker who retired in 1825 to devote himself entirely to astronomy. He reformed the *Nautical Almanac*, edited the old star catalogues of Ptolemy, Ulugh Beigh, Tycho, Halley, and Hevelius, and produced the new catalogue of the R.A.S.; reported on Pendulum Experiments to the Admiralty; and drew attention to "Baily's Beads" at the eclipse of 1836; but his chief claim to fame is his predominant share in founding the R.A.S. and invaluable work in its service. He was its first Secretary and four times President. **59 D b**

BALL. William Ball, *d.* 1690. (B)

Amateur astronomer, eldest of the seventeen children of Sir Peter Ball, of Mainhead House, Devonshire. His drawings and observations of Saturn were frequently cited by Huygens as confirming his own discovery that Saturn's "appendages" formed a ring. An observation made by Ball and his brother Peter in 1665 was interpreted in 1825 as a discovery of "Cassini's Division" ten years before Cassini; but Lynn and others proved clearly (about 1880) that this was a mistake. He was one of the founders of the Royal Society, gave a generous donation, and was the first Treasurer. **60 F h**

Birt gave the name in 1873, before Sir Robert Ball (Irish astronomer, 1840–1913) had established his reputation.

BANAT, Cape. (Kr)

A district in the Carpathians. **61 H d**

BAROCIUS. Francesco Barozzi, fl. 1570. (R)

A Venetian nobleman who wrote several original works on mathematics and translated others into Italian. In his *Cosmographia tolemaica*, published in 1585, he set forth the system of Ptolemy, and corrected various errors made by Sacrobosco. He was accused of sorcery, tried by the Inquisition, and condemned to prison. **62 DE j**

BARROW. Isaac Barrow, 1630–1677. (M)

An eminent mathematician, teacher and friend of Newton; educated at Charterhouse and Cambridge; travelled in France, Italy, and the Near East; was professor of Greek at Cambridge, then of geometry at Gresham College, and in 1664 first Lucasian professor of mathematics at Cambridge. This post he resigned after five years in favour of Newton, and devoted himself entirely to divinity. He wrote on optics and geometry; and his philosophical views are contained chiefly in his *Mathematical Lectures*. **63 E a**

BAYER. Johann Bayer, 1572–1625. (R)

Except that he was born at Rhain in Bavaria, practised for many years as advocate in Augsburg, and never married, we know nothing of his life; but he is famous as author of the *Uranometria*, or Star Atlas, published in 1603, in which he introduced the Greek letters which are still used for distinguishing stars, also the first map of the new constellations round the South Pole. **64 G j**

BEAUMONT. Élie de Beaumont, 1798–1874. (M)

Born at Canon in Normandy, taught geology at the École des Mines and later at the Collège de France, and with Dufresnoy published the *Carte Géologique de France*. He greatly influenced the development of geology, completing and extending Buch's theory of the origin of mountains, and making it possible to determine the relative ages of strata. He received many honours in his own and other countries. **65 C g**

BEER. Wilhelm Beer, 1797–1850. (B)

A Berlin banker, brother of the composer Meyer-Beer. He wished to study astronomy, and went to Mädler for instruction and advice. Like Walther with Regiomontanus, Beer became Mädler's friend and pupil, building and equipping a small observatory at his villa where they worked together. Their names are inseparably linked as joint authors of the epoch-making Map of the Moon and its accompanying book, *Der Mond* (1837), also a book on the solar system containing their observations of Mars (1828–1839), which are the foundation of modern Martian topography. **66 F c**

BEHAIM. Martin Behaim (or Behem), 1436–1506. (M)

Maker of the famous Nüremberg globe, still preserved in that city, which shows the world as it was believed to be before the discovery of America, with nothing but the Atlantic between Spain and China. It was completed in 1492, just before Columbus returned from his first voyage. Behaim was himself a daring navigator, and took part in Portuguese expeditions to the West African coast. He was a native of Nüremberg but died in Lisbon. **67 A g**

BELLOT.   Joseph René Bellot, 1826–1853.   (B)

Son of a farrier at Rochefort, he was helped to enter the naval school and thus the French Navy, and took part in Anglo-French expeditions to Madagascar and South America.   He joined in two Arctic expeditions to search for Franklin, and discovered the "Bellot Strait";   but perished by falling into a crevasse.   A monument in the Naval College, Greenwich, records that in the endeavour to rescue Franklin he shared his fate and his glory.   **68 B g**

BERNOUILLI.   Jacques Bernouilli, 1654–1705;   Jean Bernouilli, 1667–
    1748.   (Schr)

Two brothers of Dutch descent, whose family, escaping from Spanish persecution, had settled in Basle.   Both were friends of Leibniz and noted mathematicians, who taught and developed the differential calculus, influencing all the leading mathematicians of their day.   It is uncertain which Schröter meant to honour.   Jacques was professor of mathematics in Basle: he solved the problems of isochronous curves and isoperimetrical figures, and investigated the properties of the equiangular spiral.   Jean filled the chair of mathematics successively at Groningen and Basle, and inspired his pupils with enthusiasm.   His essay on Planetary Motions won a prize from the Académie des Sciences.   His three sons and two grandsons were also distinguished mathematicians.   **69 B c**

BEROSUS.   Berosus the Chaldean, *c.* 250 B.C.   (R)

A priest of Bel in Babylon, who wrote a history of Babylonia in Greek, fragments of which are quoted by Cleomedes and others. He referred to astronomical observations extending over 480 years, inscribed on bricks by the Chaldeans, maintained that the Moon was partly of fire, and observed that her periods of rotation and revolution round Earth are equal.   According to Ptolemy, he was the inventor of an old form of sundial, the hemicycle or concave hemisphere with a ball suspended above, by whose shadow is traced the Sun's daily path in the heavens.   **70 B c**

BERZELIUS.   Jöns Jakob Berzelius, 1779–1848.   (M)

Swedish chemist, born near Linköping, studied at Uppsala, was professor of botany and pharmacy at Stockholm and member of the Stockholm Academy of Sciences.   His electrochemical theory is expounded in his *Theory of Chemical Proportions and the Chemical Action of Electricity* (1814).   He isolated titanium, zirconium, and other elements, and discovered selenium;   made improvements in analytical methods;   introduced the present system of chemical nomenclature;   and was a pioneer in organic chemistry. (*See* KLAPROTH.)   **71 B c**

BESSARION.   Johannes Bessarion, *c.* 1369–1472.   (R)

Greek by birth, born at Trebizond, and titular Patriarch of Constantinople, he came to Italy in 1437 to help in an endeavour to unite

the Greek and Latin churches. He was made Cardinal and remained in Italy, doing much to further the Renaissance of Learning by his collection of Greek MSS., including Ptolemy's works, his encouragement of scholars, and his own writings. At his invitation Regiomontanus came to Italy to study Greek literature. Bessarion presented his library to Venice, and died in Ravenna. **72 H d**

BESSEL. Friedrich Wilhelm Bessel, 1784–1846. (M)

Born in Minden, Westphalia, was apprenticed as merchant's clerk in Bremen, but became interested in astronomy, and when Olbers recommended him as assistant to Schröter, at Lilienthal, he renounced a promising commercial career and "chose poverty and the stars." From 1810 until his death he was director of the observatory built under his supervision at Königsberg. He was the first to work out a systematic method of reducing observations, and from Bradley's records produced a catalogue of over 3000 stars (*Fundamenta Astronomiae*). He was also first to measure the parallax of a star, 61 Cygni, in 1838. **73 D d**

BETTINUS. Mario Bettini, 1582–1657. (R)

Italian Jesuit, born in Bologna, professor of moral philosophy and mathematics in Parma. His *Apiaria Universae Philosophiae Mathematicae* is a treasury of curious information, beautifully illustrated, on a variety of subjects, including music and perspective, sundials and perpetual-motion machines; and one section is specially devoted to astronomy. Riccioli, who lived in his birthplace and heard him lecture at Parma, mentions Bettini's attempts to measure the heights of lunar mountains. **74 G k**

BIANCHINI. Francesco Bianchini, 1662–1729. (Schr)

Born at Verona, became librarian to Pope Alexander VIII, and had an observatory in Rome, but observed chiefly at Albano. He mapped supposed spots on Venus and deduced a rotation period of more than twenty-four days. His *Hesperi et Phosphori Nova Phaenomena* contains lunar observations also, which show that he was one of the earliest observers to make separate drawings of lunar formations, and that he first discovered and figured the great Alpine Valley. His last recorded observations were of a lunar eclipse seen seventeen days before his death. **75 G b**

BIELA. Wilhelm von Biela, 1782–1856. (M)

An officer in the Austrian Army, born at Rosslau in the Harz Mountains, he fought in several campaigns of the war against Napoleon. He studied astronomy in his spare time and wrote several astronomical papers. At Josephstadt in Bohemia in 1826 he discovered "Biela's comet," calculated its orbit, and found it had a period of about six and a half years. In 1845 it divided into two, and was seen double also in 1852, but has never appeared again. The Andromedid meteors are apparently moving in its orbit. **76 C k**

BILLY.   Jacques de Billy, 1602–1679.   (R)

French Jesuit, professor of mathematics in Dijon, born in Compiègne; wrote on algebra, eclipses, the calendar, and other astronomical subjects.   His observations of the 1665 comet were published in his *Crisis astronomica de motu Cometarum*, where he argues against the theory then under discussion that comets move in straight lines.   He was influential in encouraging the tendency of his time to regard comets with scientific interest instead of fear, and he opposed astrological superstitions generally in his book *Tombeau de l'Astrologie judiciaire*. **77 J g**

BIOT.   Jean-Baptiste Biot, 1774–1862.   (M)

Just leaving college in Paris when the Revolution broke out, he joined the northern army.   Afterwards he and Arago, encouraged and aided by Laplace, went to Spain, and continued south to Formentera the arc of meridian previously measured in France.   For this he received a professorship in astronomy in Paris.   He tested the length of a seconds pendulum at many points, from Formentera to Unst in the Shetland Isles.   He wrote much on astronomical subjects, including ancient Egyptian, Chinese, and Indian astronomy, and an Arabic lunar theory of the tenth century. **78 B g**

BIRMINGHAM.   John Birmingham, 1829–1884.   (B)

This name was given to the curious square plain on the Moon enclosed by four mountain ridges because Birmingham, who was a lunar observer, was the first to call attention to it, and also to commemorate his discovery in 1866 of the remarkable Nova T Coronae, "the Blaze Star."   He made special studies of the craters Linné and Schröter, and drew up the well-known Catalogue of Red Stars.   His home and birthplace was in Tuam, Ireland. **79 F a**

BIRT.   William Radcliff Birt, 1804–1881.   (N)

A lunar observer, through whose initiative the Selenographical Society was founded, and who reported to the British Association for the Committee for Mapping the Surface of the Moon (1865–1869). He found eruptions on the crater Linné, and described the streaks on Plato.   He also did research work on the Zodiacal Light, sunspots and solar rotation, physics of the atmosphere and law of storms. **80 F g**

BLAGG.   Mary Adela Blagg, 1858–   .   (Lam)

Born at Cheadle in Staffordshire, educated at home, and taught herself algebra and trigonometry.   She compiled the *Collated List of Lunar Formations*; and the greater part of the work done by the I.A.U. Commission for Lunar Nomenclature, including the drawing of outer sections for the Map, is due to her indefatigable perseverance (*Named Lunar Formations*, by Blagg and Müller, 1935).   She also tabulated and discussed several series of variable star observations, and wrote on a suggested *Substitute for Bode's Law*. **81 E e**

BLANC, Mt. (Schr) **82 F b**

BLANCANUS. Giuseppe Biancani, 1566–1624. (R)

Born in Bologna and was appointed professor of mathematics in Parma. He constructed and described a sundial, and wrote on geography, astronomy, and mathematics, his chief work being the *Sphaera Mundi*. His treatise *Instrumentum Horologicum* was first published by Riccioli, who was his pupil. He died in Paris. **83 F k**

BLANCHINUS. Giovanni Bianchini (Johannes Blanchinus), fl. 1458. (Schr)

Born in Bologna and died in Ferrara, where he was a teacher of astronomy. He drew up astronomical tables for Ferrara, based on the Alphonsine, and explained and dedicated them to his patron, the Emperor Frederick III, "to whom he was both well known and acceptable." **84 E h**

BODE. Johann Elert Bode, 1747–1826. (Lo)

He is chiefly known by "Bode's Law" of the numerical relationship of planetary distances from the Sun. He was Director of Berlin Observatory, published star charts and a star atlas, and edited for fifty years the *Berlin Astronomisches Jahrbuch*. His contribution to selenography was a discussion of the luminous regions in the dark part of the Moon. **85 F e**

BOGUSLAWSKY. Palon Heinrich Ludwig von Boguslawsky, 1789–1851. (M)

An artillery officer in the Prussian Army, born in Magdeburg, who was appointed Director of the Breslau Observatory. He observed Uranus, and the disappearance of Saturn's rings, and was the discoverer of the comet of April 1835. (His son, Georg Heinrich Boguslawsky, wrote on meteors and comets, but many of his father's papers have been wrongly attributed to him.) **86 D k**

BOHNENBERGER. Johann Gottlieb Friedrich von Bohnenberger, 1765–1831. (M)

Son of a pastor, he was himself ordained, but devoted himself later to mathematics and astronomy, and became professor at Tübingen University. He wrote on astronomy, and was the inventor of the "Bohnenberger Apparatus" for demonstrating precession and Earth's rotation, and the "Bohnenberger" (collimating) eyepiece. **87 B g**

BOND, G. P. George Philip Bond, 1826–1865. (B)

Born at Cambridge, Mass., where he succeeded his father (*see below*) as Director of Harvard College Observatory. He wrote on the light of Jupiter, comparing it with that of the Moon, studied Saturn's rings and was the first to assert that they could not be solid, and was also a pioneer in stellar and cometary photography. **88 C c**

BOND, W. C. William Cranch Bond, 1789–1859. (B)

A watchmaker, born in Maine, U.S.A., who was attracted to astronomy by the eclipse of 1806. He visited England to see the observatories there, and after many years' work in his own was appointed first Director of Harvard College Observatory. He discovered Saturn's "crape ring," seen only vaguely by earlier observers, and (simultaneously with Lassell in England) Saturn's 8th satellite Hyperion. His daguerreotype of the Moon, shown at the Great Exhibition of London in 1851, was an early demonstration of celestial photography. (*See* GALLE.) **89 E a**

BONPLAND. Aimé Bonpland, 1773–1858. (M)

French botanist who accompanied Humboldt on his travels in Mexico, Columbia, and up the rivers Orinoco and Amazon. When exploring in disputed territory between the Argentine and Paraguay he was arrested as a spy, and detained for ten years, then returned to the Argentine and cultivated oranges at Santa Ana, where he eventually died. He collected over 6000 plants, mostly unknown, and wrote *Les Plantes Equinoxiales.* **90 G f**

BORDA. Jean Charles Borda, 1733–1799. (M)

French naval officer and astronomer, born at Dax. He constructed and perfected the reflecting circle devised by Tobias Mayer, and invented or improved many other instruments and methods for navigation and survey work. In 1771–1772 he voyaged with Pingré to determine latitude and longitude by different methods and test the clocks of the French Navy. In 1782 he was taken prisoner at sea by the English, but immediately released on parole. In 1788 he reported on units of measurement with Laplace, Lagrange, Monge, and Condorcet. **91 B h**

BOSCOVICH. Ruggiero Giuseppe Boscovich, 1711–1787. (M)

Born at Ragusa, was professor in Rome of mathematics and physics, travelled through Europe, and then went to Paris as director of marine optics, going back to Italy in 1783. He wrote on sunspots and on the lunar atmosphere, and observed the transit of Mercury (1737) and a lunar eclipse (1744). **92 E e**

BOUGUER. Pierre Bouguer, 1698–1758. (Schr)

Born at Croisic in Brittany, where he succeeded his father as professor of hydrography, and later filled the same post at Havre. He took part with Condamine and Godin in measuring an arc of meridian in Peru, and tested the deflection of the plumb-line on Mt Chimborazo. He was the first to construct a heliometer, and measured the diameters of Sun, Moon, and the major planets: he also compared the light of Sun and Moon with candles of various powers. He died in Paris. **93 G b**

BOUSSINGAULT. Jean-Baptiste Dieudonné Boussingault, 1802–1887. (M)

Born in Paris, spent his early manhood in South America. He measured the night radiation on the Cordilleras and the mean temperature of the torrid zone, also investigated the composition of the atmosphere and the oxidation of iron meteors. But his special work was agricultural chemistry and botany; his *Agrimonie, chimie agricole, et physiologie* was widely read and translated, and he was professor of chemistry first in Lyons, then in Paris, where he died. **94 D k**

BOUVARD. Alexis Bouvard, 1767–1843. (M)

A shepherd boy, born in a hut at Chamonix, he went to Paris at eighteen without means or prospects, attended the free public lectures at the Collège de France, and taught mathematics. Laplace engaged him as computer, and found his assistance invaluable. He was elected to the Académie des Sciences and shared with Bürg their prize for a contribution to the lunar theory; discovered several comets, and made tables of Jupiter, Saturn, and Uranus. **95 J j**

BRADLEY. James Bradley, 1692–1762. (Schr)

While an Oxford undergraduate he often visited his uncle, James Pound, an ardent amateur astronomer, and observed with him. Halley's attention was attracted, and they became lifelong friends. Bradley became Vicar of Ross, but resigned to accept the Savilian Professorship of Astronomy in Oxford; and in 1742 succeeded Halley at Greenwich as Astronomer Royal. His great discoveries were aberration of light and nutation; and his accurate measures of star positions were used by Bessel for the *Fundamenta Astronomiae*. **96 E cd**

BRAYLEY. Edward William Brayley, 1801–1870. (B)

A student under Faraday, he became professor of physical geography and meteorology at the Royal Institution, London. He wrote chiefly on the composition of meteorites and on the observation of luminous meteors. He was born and died in London. **97 H d**

BREISLAK. Scipione Breislak, 1748–1826. (Smt)

Italian geologist and chemist, born in Rome. He was professor of mathematics and physics, first at Ragusa and afterwards in Rome, and Napoleon appointed him inspector of saltpetre and gunpowder factories. He studied the geology of Vesuvius and other regions in Italy, and wrote an *Introduzione alla Geologia* (1811). He died in Milan. **98 D j**

BRENNER. Leo Brenner, 1855–1928. (Fauth)

Born in Trieste, and was an officer in the Austrian Army; but he retired early, and in 1893 built the well-equipped "Manora

Observatory," in Lussinpiccolo, named after his wife. They observed chiefly the Moon and planets. He founded the periodical *Astronomisches Rundschau*, and wrote several books for amateur astronomers. He died at Meran in the Tyrol. **99 C j**

BRIGGS. Henry Briggs, 1556–1630. (Schr)

One of the first to recognize the value of Napier's invention of logarithms, to him was chiefly due its rapid adoption throughout Europe for all practical calculations. His own logarithmic tables were published in 1617 and 1624, and completed by Vlacq in 1628. He was born near Halifax in Yorkshire, was Gresham Professor of Geometry, then Savilian Professor at Oxford from 1619 till his death. (*See* NEPER.) **100 K c**

BRISBANE. Sir Thomas Brisbane, 1770–1860. (Smt)

Born in Renfrewshire, Scotland. General in the British Army, and Governor successively of Jamaica, St Vincent, and New South Wales, where he founded and equipped the first regular observatory in the southern hemisphere at Parramatta in 1882, and made a catalogue of stars. He devised methods of determining time with accuracy, and finding latitude from circum-meridian lunar observations. Brisbane river, discovered by him, and Brisbane city, built upon it, were named after him. **101 B j**

BROWN. Ernest William Brown, 1866–1938. (Com)

Born in Hull, Yorkshire. At Cambridge in 1888 Professor G. H. Darwin suggested to him to study G. W. Hill's papers, and these roused his interest in the lunar theory, which became the chief work of his life. After taking his Cambridge degree, he went as professor of mathematics to Haverford College, U.S.A., and later to Yale, but was encouraged to continue his chosen research. In 1907, when the first stage was completed, he received the R.A.S. Gold Medal and the Pontécoulant Prize; later, completed the whole problem; then turned his attention to planetary and stellar motions. **102 FG j**

BRUCE. Catherine Wolfe Bruce, 1816–1900. (Kr)

Daughter of George Bruce, the American typefounder. She was an accomplished woman, interested in art, science, and literature; and she gave with sympathy and generosity to astronomers and astronomical institutions in her own and other countries. The minor planet Brucia was so named by Wolf of Heidelberg in gratitude for her gift of the photographic telescope with which he discovered it. **103 E e**

BUCH. Christian Leopold von Buch, 1774–1853. (M)

German geologist, born at Stolpe in Prussia, and died in Berlin. He made a special study of the Jurassic and Cretaceous periods, and was in many ways a pioneer of modern geology. He was a foreign associate of the Institut de France. **104 D j**

BULLIALDUS. Ismael Boulliaud, 1605–1694. (R)

French astronomer, historian, and theologian, who travelled extensively through Europe before settling as a priest in Paris. His *Astronomia Philolaica*, so called from his belief that Philolaus had taught the same system as Copernicus, summarized the astronomical knowledge of his day. In it he introduced the name of "evection" for the inequality in the Moon's motion discovered by Ptolemy. He was the first to recognize the eleven-month periodicity of Mira Ceti (*See* PHOCYLIDES.) **105 G g**

BURCKHARDT. Johann Karl Burckhardt, 1773–1825. (M)

German astronomer, born at Leipzig. After studying practical astronomy under Zach, in the Seeberg Observatory (Gotha), he went to Paris and was assistant to Lalande in the Bureau des Longitudes. He did valuable work for the *Connaissance des Temps*; and his Lunar Tables, published by the Bureau, superseded those of Bürg and were adopted by the British Nautical Almanac Office in 1821. From 1818 he was member of the Bureau, and he died in office, in Paris. **106 B c**

BÜRG. Johann Tobias Bürg, 1766–1834. (M)

Born in Vienna, of parents in poor circumstances, his talents won for him influential friends who enabled him to study astronomy and work at the University Observatory, and he became assistant to Triesnecker. He won a prize for a treatise on the Moon's orbit, and his Lunar Tables, published in Paris, and adopted for compiling the *Nautical Almanac* in England (1813–1820), brought him fame; but increasing deafness made time-observations difficult, and when Triesnecker died the directorship was given to Littrow. Bürg lived in retirement, but found consolation in friends and much-loved woodland birds. **107 D b**

BURNHAM. Sherburne Wesley Burnham, 1838–1921. (Kr)

Amateur astronomer, born at Thetford, U.S.A., who for fifty years gave all his spare time to skilful and accurate study of double stars. With a six-inch refractor he discovered 451 new pairs, then had the use of the largest telescopes in American observatories, and discovered in all over 1300, also re-observed and computed orbits for many already known, and drew up a fundamental General Catalogue. Among his friends were Dembowski and Webb, whose text-book was his first guide. **108 E g**

BÜSCHING. Anton Friedrich Büsching, 1724–1793. (M)

German geographer and professor of philosophy at Göttingen. He lived for some time in St Petersburg and preached in a Lutheran church, then from 1766 was Director of the Kölnisches Gymnasium in Berlin. He published twenty-two volumes of a *Magazin für Historie und Geographie* (1767–1793), and five of *Neue Erdbeschreibung*. **109 D j**

BYRGIUS. Joost Bürgi, 1552–1632. (R)

Swiss clockmaker, engaged by Wilhelm of Hesse-Cassel. He invented and made pendulum clocks (re-invented later) for use in the Cassel Observatory, where his mechanical and mathematical talents were discovered and valued. Later, he was clockmaker to the Emperor Rudolf II at Prague. He wrote on mathematics and instruments. (*See* WILHELM I.) **110 K h**

CABAEUS. Niccolo Cabeo, 1586–1650. (R)

Born at Ferrara, professor of philosophy at Parma. He seems to have been the first to note the phenomenon of electrical repulsion, for in his *Philosophia Magnetica* (1629) he describes how filings are attracted and then repelled by excited amber. He also wrote on comets, the Galaxy, and other astronomical subjects, and made experiments with lenses, although he failed to invent the telescope. He died at Genoa, where "with great applause" he had taught mathematics. **111 F k**

CALIPPUS. Fl. 330 B.C. (R)

Greek astronomer of Cyzicus, a pupil of Eudoxus. The additions he made to his master's system of homocentric spheres, and the superiority of his 76-year cycle over Meton's of 19 years, show that he had carefully observed the motions of Sun and planets, and especially of the Moon, and could represent and calculate them with greater approach to accuracy than his predecessors. **112 E b**

CAMPANUS. Giovanni Campano, thirteenth century. (R)

Of Novara in Lombardy. His age is sometimes given as eleventh or twelfth century, but it is known that he was chaplain to Urban IV when Pope, 1261–1264. He edited a Latin Euclid based on the translation from Arabic by Adelard of Bath and on Arabic manuscripts brought home by himself from travels in the East. He also wrote on planetary theory, spheres, and other astronomical subjects. According to Riccioli, he was famous for inventing a new method of dividing the astrological "Houses." **113 H h**

CAPELLA. Martianus Capella, fifth century A.D. (R)

A Carthaginian lawyer, author of an encyclopædic work, *The Nuptials of Mercury and Philology*, which became a standard text-book of the Middle Ages. The eighth book of this is on astronomy, and in one chapter, called *Earth not the Centre of all the Planets*, he explains an ancient theory (of doubtful origin) that Venus and Mercury revolve round the Sun, while Sun and other planets revolve round Earth. Copernicus alludes to this passage in his *De Revolutionibus.* **114 C f**

CAPUANUS. Francesco Capuano di Manfredonia, fifteenth century A.D. (R)

Professor of astronomy in Padua. Afterwards he entered the Church, and became a bishop and canon of the Lateran Cathedral,

changing his first name to Johannes-Baptista. He wrote commentaries on Sacrobosco's *Sphere* and Purbach's *Planetary Theories*, also on ecclesiastical computations and the construction of the quadrant. **115 G h**

CARDANUS. Girolamo Cardano, 1501–1576. (R)

Son of a Milan lawyer, he won fame as an astrologer though his forecasts often failed, and as a doctor he cured many by his unorthodox common-sense remedies. He was summoned to prescribe for a Scottish archbishop, and had an audience of Edward VI of England, who "asked intelligent questions about the Milky Way." As mathematician, his algebra was a great advance on previous work: in his *Ars Magna* (1545) he analyses cubic equations, and deals for the first time with negative roots. When imprisoned for heresy, he was protected by the Pope, and died as Papal Astrologer in Rome. **116 K d**

CARLINI. Francesco Carlini, 1783–1862. (M)

Italian astronomer, born in Milan, where he was for many years Director of the Observatory. His chief interest was in celestial mechanics, and in 1820 he was awarded a prize by the French Institute for his lunar theory. He ascended Mt Blanc in 1821 to measure the variation of gravity at different altitudes by determining the length of the seconds pendulum. **117 G c**

CARPATHIANS, Mts. (M) **118 G d**

CARPENTER. James Carpenter, 1840–1899. (Gaud)

Best known as Nasmyth's collaborator in writing *The Moon*. He was born at Greenwich; was computer, then assistant, at the Royal Observatory; made drawings of the lunar crater Linné after the suspected change, also of planets, comets, and the Orion Nebula, and in 1863 began to study stellar spectra. He married Ellen Penn, and in 1872 left the observatory to join the firm of Penn and Sons, marine engineers. He died at Lewisham. (*See* NASMYTH.) **119 G a**

CARRINGTON. Richard Christopher Carrington, 1826–1875. (B)

After three years at Durham Observatory he built his own at Redhill, Surrey. From past records, and his own observations and drawings, he found the rate of the Sun's rotation, its variation with latitude, and the inclination of the solar axis, and showed that sunspots are restricted to definite zones which vary with the eleven-year cycle. Business, then illness, hindered further work, and he died at Churt in Surrey. **120 B b**

CASATUS. Paolo Casati, 1617–1707. (R)

Italian theologian and mathematician, a Jesuit priest through whose instrumentality Queen Christina of Sweden, daughter of Gustavus Adolphus, the champion of Protestantism, was converted to Catholicism. **121 F k**

CASSINI. Giovanni Domenico Cassini, 1625–1712. (Schr)

Italian astronomer, who was invited to Paris by Louis XIV and made the first Director of Paris Observatory. He observed and charted the Moon, greatly advanced the theory of her libration, and discovered interesting relations between her equator and orbit; drew up tables of Jupiter's moons, and discovered his rotation; but he is specially famous for discovering four of Saturn's satellites, his bands, and the dark marking in his ring known as "Cassini's division." **122 E b**

CASSINI, J. J. Jacques Cassini, 1677–1756. (Schr)

Son of the above, and born in Paris, where he succeeded his father as Director of the Observatory, and was succeeded by his son and grandson. He is chiefly known by his *Élémens d'Astronomie*, and his share in the French enterprise of measuring an arc of meridian from Dunkirk to the Pyrenees in order to determine the figure of the Earth. **123 F a**

CATHARINA. St. Catherine of Alexandria, *d.* A.D. 307. (R)

There are many Catherines in history, but Riccioli prefaces this name with an S. for Sancta, and places her beside Saints Theophilus and Cyrillus of Alexandria, so she is the beautiful Virgin and Martyr who has the wheel for her symbol. Doubtless she was chosen for her great learning, and for the story that being confronted with an assembly of pagan philosophers she defended the Christian faith and defeated all their arguments, hence was adopted as patron of Christian philosophers. **124 D g**

CAUCASUS, Mts. (M) **125 E b**

CAUCHY. Augustin Louis Cauchy, 1789–1857. (N)

Born in Paris, practised for some time as an engineer, then was professor of mathematics at the École Polytechnique and the Collège de France. In 1830 he left France and was appointed professor at Turin; after his return he was professor of mathematical astronomy. He wrote on the wave theory of light and many other important mathematical works. **126 B e**

CAVALERIUS. Buonaventura Cavalieri, 1598–1647. (R)

Italian mathematician whose "method of indivisibles" marked a new stage in the development of mathematics and led up to the invention of the calculus. He was a pupil of Galileo and professor of mathematics in Bologna University. He constructed a "planetary wheel" from Lansberg's tables to show the positions of the planets at any time, and wrote on astronomy and other subjects. Riccioli says he himself received help and encouragement in his astronomical work from this most kindly and most learned man. **127 K e**

CAVENDISH. Henry Cavendish, 1731–1810. (M)

A pioneer in modern chemistry and physics. He discovered hydrogen, and was the first to form water by combining it with oxygen. By means of the "Cavendish Experiment" with torsion balance he determined the density and hence the mass of the Earth. He was shy and reserved, lived alone in London, and never married. **128 J h**

CAYLEY. Arthur Cayley, 1821–1895. (B)

The first Sadlerian Professor of Pure Mathematics at Cambridge, appointed in 1863; President of the Royal Astronomical Society, 1872–1874; and of the British Association in 1883. His most important work is *Elliptic Functions.* Some of his many mathematical papers deal with spherical and physical astronomy, and in 1862 he reported to the British Association on the secular acceleration of the Moon's mean motion. **129 D e**

CELSIUS. Anders Celsius, 1701–1744. (Smt)

Best known as the constructor of the Centigrade thermometer (1742), universally used in science. (On his scale, 0° marked the boiling-point of water, 100° the freezing: Linnæus reversed this.) Celsius was professor of astronomy in Uppsala, his birthplace, where an observatory was built for his work; and he shared in the French geodetic expedition to Lapland under Maupertuis. He observed and wrote on the Aurora Borealis, and studied the photometry of Sun and Moon. **130 D h**

CENSORINUS. Fl. A.D. 238. (R)

This is the date of his *De Die Natali*, addressed to a friend on his birthday. The subject of birth and birthdays leads to a discussion of stellar influences and methods of recording time, and thence to astronomy and chronology in general, including the various cycles of years devised by Chaldeans, Egyptians, and Greeks. He was a Latin grammarian, and wrote other treatises, one on geometry, but these are lost, and nothing further is known about the author. **131 C f**

CEPHEUS. (R)

Mythical king of Ethiopia, said to have been "a great Astronomer, or at least a Favourer of the professours of that Science, who in grateful acknowledgment" gave his name to a constellation. **132 C b**

CHACORNAC. Jean Chacornac, 1823–1873. (B)

The first to perceive the astonishing variability in brightness of Hind's nebula in Taurus (1854 and 1858), but chiefly known for his discovery of six asteroids. He began an *Atlas Écliptique* to facilitate the search, but died before its completion. He was born in Lyons, but most of his work was done at Paris Observatory. **133 C c**

CHALLIS.   James Challis, 1803–1862.   (B)

Born at Braintree, in Essex, ordained in 1830, and in 1836 appointed Plumian professor and Director of the University Observatory at Cambridge.   Here he began in July 1846 to search for Neptune in the position calculated by Adams, but did not identify it until September 29.   He determined positions of Sun, Moon, and planets to increase tabular accuracy, improved the collimating eyepiece, and wrote on astronomy, physics, and mathematics. (*See* GALLE and ADAMS.)   **134 E a**

CHEVALLIER.   Temple Chevallier, 1794–1873.   (Lee)

Descended from a French family which came to England in the sixteenth century and settled in Suffolk; became parish priest of Esh, also professor of mathematics and reader in astronomy and Hebrew at Durham University; later canon of Durham Cathedral and director for thirty years of the newly founded Durham Observatory.   Although much occupied by clerical and professorial work, he observed planets and lunar occultations, and presented to the R.A.S. his long series of sunspot observations.   **135 C b**

CHLADNI.   Ernst Florens Friedrich Chladni, 1756–1827.   (Smt)

"Chladni's Figures" are symmetrical systems of lines appearing on vibrating plates, which make visible in a striking way the dependence of pitch in musical notes on the rate of vibration in their source.   On this German physicist's work is based much of the later development of the science of sound.   He was also the first to prove (1794) that meteoric stones are not of terrestrial origin but fall from the sky.   He was born at Wittenberg and died at Breslau.   **136 E e**

CICHUS.   Francesco degli Stabili, better known as Cecco d'Ascoli, 1257–1327.   (R)

Born at Ascoli, he became professor of astronomy in Bologna, where he lectured and cast horoscopes.   He wrote a commentary on Sacrobosco's *Sphaera Mundi*, and an encyclopædic poem called the *Acerba*, part of which deals with astronomy.   Being accused of heresy and necromancy, he was burned at the stake in Florence.   His Latinized name was Cichus Asculanus.   **137 G h**

CLAIRAUT.   Alexis Claude Clairaut, 1713–1765.   (M)

A mathematical genius, who when ten years old studied the infinitesimal calculus, and at twelve presented a memoir to the Académie des Sciences.   After sharing in Maupertuis' Lapland expedition (*see* LEMONNIER, CONDAMINE), he wrote the classic *Théorie de la Figure de la Terre*.   He solved the motion of the Moon's perigee which had baffled Newton, and computed the return of Halley's comet.   He had great charm and was popular in Paris society.   **138 E j**

CLAUSIUS.   Rudolf Julius Emmanuel Clausius, 1822–1888.   (N)

Born in Pomerania, he held professorships of physics successively in Zürich, Würzburg, and Bonn.   He made thermodynamics a science, was the chief founder of the kinetic theory of gases, and advanced the theory of electrolysis.   **139 H hj**

CLAVIUS.   Christopher Klau, 1537–1612.   (R)

German Jesuit, born at Bamberg.   A mathematical teacher and writer, so highly esteemed in his day that he was called the Euclid of the sixteenth century and Pope Gregory entrusted to him the reform of the Calendar in 1582 on the lines laid down by Lilius.   He wrote on astrolabes and Sacrobosco's Sphere, and at the Collegio Romano in 1572 observed Tycho's new star.   **140 F k**

CLEOMEDES.   First century B.C. or later.   (R)

Greek author of a treatise on astronomy, valuable chiefly because based on earlier writings now lost.   He describes how Eratosthenes and Posidonius measured Earth's circumference, discusses the size of the Sun and the motions of the planets, maintains that lunar eclipses are always caused by Earth's shadow, and explains how by refraction the Sun may be visible when actually below the horizon.   **141 B c**

CLEOSTRATUS.   *c.* 500 B.C.   (R)

Greek poet-astronomer, of Tenedos, said to have watched the stars from Mount Ida.   He improved the calendar at Athens by introducing a luni-solar eight-year cycle, the octaeteris, in which some months had 29 and some 30 days, and the average length of the year was $365\frac{1}{4}$ days. Possibly he also introduced the zodiacal constellations from Babylon. **142 H a**

COLOMBO.   Christopher Columbus, *c.* 1446–1506.   (M)

The discoverer of America.   Having gained the support of Queen Isabella of Castile, he set sail with three small ships to find a western passage to China, and in October 1492 landed in the Bahama Islands. In this and subsequent voyages, the ephemerides of Regiomontanus enabled him to determine his approximate longitudes, also to impress the inhabitants of Jamaica by predicting a lunar eclipse.   **143 B g**

CONDAMINE.   Charles Marie de la Condamine, 1701–1774.   (Schr)

French physicist and astronomer, at one time in the army.   With Godin and Bouguer he went to Peru in 1735 and measured an arc of meridian about 3° long near the equator.   This, when compared with similar measures made in Lapland by Maupertuis, confirmed Newton's opinion of Earth's figure as flattened at the poles, and disproved Cassini's.   After eleven years in South America, Condamine returned to France, and wrote an account of his travels.   **144 G b**

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CONDORCET. Jean de Condorcet, 1743–1794. (Schr)

French mathematician and philosopher. He wrote on cometary theory, and with Bossuet, d'Alembert, and Lalande compiled the mathematical part of the great *Encyclopédie Méthodique*; and he was on the commission which formulated the metric system of weights and measures. Elected member of the Legislative Assembly, he drew up a memorandum for the suspension of the king, but opposed his execution, and was proscribed. Shortly before his own execution he wrote his *Progrès de l'Esprit humain*. **145 A de**

CONON. *c.* 260 B.C. (R)

Greek mathematician and astronomer of Samos, the friend of Archimedes, who praised him highly. His astronomical observations are referred to by Ptolemy, but none of his works are extant. He is said to have named the constellation Coma Berenices when Queen Berenice dedicated her hair to the gods in thanks for the safe return of her consort, Ptolemy Euergetes, king of Egypt and patron of Conon. **146 E d**

COOK. James Cook, 1728–1779. (M)

Naval captain and explorer who twice sailed round the world and received the Copley Medal of the Royal Society for his discoveries. He reported on a solar eclipse (1766) and observed a transit of Venus from Tahiti (1769). He charted the coasts of New Zealand and eastern Australia, explored southern seas for a supposed great continent, and northern for a north-west passage. He lost his life in a brush with natives of Hawaii. **147 B g**

COPERNICUS. Nicholas Copernicus, 1473–1543. (R)

Born at Thorn, on the Vistula; studied at Cracow University and then in Italy, working at Bologna and Padua, graduating at Ferrara, and visiting Rome; finally settled at Frauenburg, where he had been appointed canon. His *De Revolutionibus*, published only when he was dying, explains his system wherein Earth and planets revolve round the Sun. It gradually won acceptance over the Ptolemaic system, dominant for thirteen centuries, in which Earth was central; and the Copernican system is the foundation of modern astronomy. **148 G e**

CORDILLERA, Mts. (M) **149 K g**

CRISIUM, Mare. Sea of Dangers. (R) **150 AB d**

CROZIER. Francis Rawdon Moira Crozier, 1796–1848. (B)

Naval captain, who began his career as mate of a sloop sailing to the Cape of Good Hope in 1818. He shared in expeditions to the Arctic with Parry and the Antarctic with Ross, and was at last lost in the Arctic with Franklin after the discovery of the North-West

Passage: traces and records were found in 1859. Birt places him with McClure and Bellot near Mädler's Columbus, Cook, and Magellan, in a lunar region which he refers to as "Navigators' Corner." **151 B g**

CRÜGER. Peter Crüger, 1580–1639. (R)

Chiefly known as the teacher of Hevelius, who refers to him as "my Preceptor and a greatly honoured mathematician of Danzig, whose diligence and skill words fail me worthily to extol." He was born in Königsberg, and became professor of mathematics and poetry in the gymnasium at Danzig. Among his many writings were treatises on trigonometry, on Earth's daily rotation, and the *Uranodromus Cometicus*; but his *Astronomia Dantiscana* was never completed. **152 K g**

CURTIUS. Albert Curtz, 1600–1671. (R)

German Jesuit astronomer, rector of the college of Dillingen on the Danube, born in Munich. He won the gratitude of Tycho's many admirers by printing a long series of his unpublished observations, and, adding some others by various astronomers, called the whole *Historia Coelestis* (Augsburg, 1666). His own work on the lunar theory was ingenious and is praised by Kepler in his *Rudolphine Tables*. **153 E k**

CUSANUS. Nikolaus Krebs, 1401–1464. (Smt)

Born at Cues, on the Moselle. His father, a German wine-grower, treated him harshly, so he ran away, and studied at Heidelberg, Bologna, Padua, and became a mathematician, a great scholar, and a Cardinal. He urged calendar reform, and in his *De docta Ignorantia* suggested arresting ideas, especially that Earth was perhaps neither stationary nor at the centre of the World, but only seemed so to those living on it. He bequeathed his valuable library to Cues, died at Todi, and was buried in Rome. **154 D a**

CUVIER. Georges Cuvier, 1769–1832. (M)

Famous French naturalist and palæontologist; tutor in a private family, later professor in the Collège de France. His paper on *Elephants*, living and fossil, and his *Lessons on Comparative Anatomy* were published in 1800; and his *Règne Animal* (1830) embodies the results of all his researches on structure and classification of animals. He was made a peer of France and President of the Council of State. **155 E j**

CYRILLUS. Saint Cyril, *d.* A.D. 444. (R)

He followed Theophilus as Bishop of Alexandria in 412, and also in devising a new cycle for determining the date of Easter. Both were based on the nineteen-year cycle of Meton. **156 CD g**

CYSATUS. Jean-Baptiste Cysat, 1588–1657. (R)

A Swiss Jesuit, born and died in Lucerne. He was a pupil of Scheiner and succeeded him as professor of mathematics and astronomy in Ingolstadt. He was the first to make telescopic observations of a comet, and wrote much concerning the comet of 1618: his, too, is the earliest recorded discovery of the Orion Nebula, in the same year. (*See* PEIRESCIUS.) **157 F k**

DAGUERRE. Louis Daguerre, 1789–1851. (Smt)

A landscape painter, born in Normandy, lived in Paris. He first discovered how to fix permanently by chemical means the image of an object focused on a plate. His "daguerreotype" process, with silvered copper plates, was announced in 1839 by Arago, and made him famous. It was the forerunner of photography, an invaluable aid to astronomy. **158 C g**

D'ALEMBERT. Jean-le-Rond d'Alembert, 1717–1783. (Schr)

A waif found on the steps of the church St-Jean-le-Rond, who became a famous mathematician and a member of the Académie des Sciences. His *Traité de Dynamique* deals with general dynamic problems, but he also investigated and threw fresh light on special astronomical subjects such as precession, nutation, and the lunar theory. Like Euler and Clairaut, he gave this a new form by using analytical instead of geometrical methods. His nature was simple and generous. **159 F k**

DAMOISEAU. Marie Charles Théodor de Damoiseau, 1768–1846. (M)

Born at Besançon. He was artillery officer in foreign countries and assistant at Lisbon Observatory before becoming director of the Military School in Paris and member of the Bureau des Longitudes. He compiled tables of Jupiter's satellites and computed the perturbations of Halley's and Biela's comets, but is chiefly known among astronomers for his work on the lunar theory and lunar tables, and his determination of the Moon's mass and parallax. **160 K f**

DANIELL. John Frederick Daniell, 1790–1845. (B)

Physicist and meteorologist, born in London, and was professor of chemistry at King's College there. He invented the hygrometer in 1820 and obtained the first precise measures of moisture in the atmosphere; confirmed Faraday's discoveries concerning the chemical action of electricity, and constructed "Daniell's Cell," which provided a constant current for any required length of time. **161 C c**

DARNEY. Maurice Darney, 1882–   . (Lam)

Born in Paris, and became an enthusiast for astronomy at the age of fourteen; has observed for many years at the Observatory of the Société Astronomique de France, and since 1930 at Paris Observatory,

his specialty being the Moon. He has published many lunar observations, including detailed studies of special formations, discussions of recent lunar theories, and reviews of the work of Delmotte, Lamèch, and others, in the *Bulletin* of the Société Astronomique, the Greek journal *Ourania*, and the Belgian *Ciel et Terre*. **162 G g**

D'ARREST. Heinrich Ludwig d'Arrest, 1822–1875. (Smt)

German astronomer, born in Berlin, for some time assistant to Encke at the observatory there, and from 1857 professor in Copenhagen University. He made special studies of comets, and of asteroids, especially the complexity of their interwoven orbits, and he published observations of about 2000 nebulæ, including many newly discovered. **163 D e**

DARWIN. Charles Darwin, 1809–1882. (Smt)

Born in Shrewsbury. His observations during the voyage of the *Beagle* (1831–1836), on which he was naturalist, laid the foundation of his theory of Evolution by Natural Selection, which he first announced in an essay presented to the Linnean Society in 1858. This was followed by his books *On the Origin of Species*, *The Descent of Man*, and many others describing his researches on plant and animal life. He lived and died at Down, in Kent, and was buried in Westminster Abbey. **164 K gh**

DA VINCI. Leonardo da Vinci, 1452–1519. (Peu)

Florentine artist, painter of some of the world's masterpieces; also poet and mathematician, architect and engineer. He was constantly experimenting with applications of hydraulics and mechanics, and especially attempts to perfect machines for flying; and his numerous unpublished notes show his interest also in physics, anatomy, geology, astronomy. **165 B e**

DAVY. Humphry Davy, 1778–1829. (M)

The inventor of the miner's safety-lamp was born at Penzance, and taught himself chemistry and physics. He became assistant lecturer and editor, and then professor, at the Royal Institution, London; and his researches and discoveries, especially in electro-chemistry, brought him European fame. He was President of the Royal Society, 1820–1827. **166 F g**

DAWES. William Rutter Dawes, 1799–1868. (Schr)

This "eagle-eyed" observer discovered Saturn's dusky ring independently, very soon after Bond, and made drawings of Mars from which the first reliable Martian map was made (by Proctor in 1869). He also detected fine details in sunspots, using a solar eye-piece of his own design, and made a series of micrometric measures of double stars. He began his career as a clergyman, but later took a degree in medicine and practised at Haddenham in Berkshire. **167 C d**

DEBES.   Ernest Debes, 1840–1923.   (Mül)

German cartographer, born at Neukirchen, near Eisenach.   He founded the Geographical Institute of Warner and Debes in Leipzig, which published a great number of school and wall maps.   He is author of a small *Lunar Atlas*, a *Handy Map of the Moon*, and a *Map of the Moon* based on that of Goodacre, chiefly following the Paris photographic *Atlas*.   **168 B c**

DECHEN.   Ernst Heinrich Karl von Dechen, 1800–1889.   (Smt)

German mineralogist and geologist, born in Berlin.   He held appointments as a mining surveyor in Berlin and Bonn, and visited both England and Scotland for geological surveys; but he is re-membered essentially as an authority on the strata of Westphalia and the Rhineland.   He died in Bonn.   **169 J b**

DE GASPARIS.   Annibale de Gasparis, 1819–1892.   (Smt)

Italian astronomer, for many years Director of the Capodimonte Observatory, near Naples, where he discovered nine minor planets. He devoted most of his efforts to their theory and the publication of their orbits and ephemerides.   He died in Naples.   **170 J h**

DELAMBRE.   Jean-Baptiste Joseph Delambre, 1749–1822.   (Lo)

Author of a valuable *Histoire de l'Astronomie* in five volumes, which is essentially an account of the writings of astronomers of all ages, including many mediæval MSS.   He was born at Amiens, studied under Lalande, and succeeded him as professor of astronomy at the Collège de France.   He was a skilful and indefatigable com-puter of planetary tables, and took part in the trigonometrical survey on which the French metrical system is based.   **171 D f**

DE LA RUE.   Warren de la Rue, 1815–1889.   (B)

Born in Guernsey, educated in Paris, son of a successful English paper manufacturer.   He built a private observatory and was one of the first to apply photography successfully to astronomy.   In 1852 he constructed a telescope, optical parts included, and obtained beautiful photographs of the Moon, in 1857 of the Sun.   The eclipse photographs taken by himself and Secchi in Spain in 1860 definitely settled the disputed question whether the prominences belonged to Sun or Moon.   **172 CD a**

DELAUNAY.   Charles Eugène Delaunay, 1816–1872.   (B)

French astronomer who devoted his mathematical gifts mainly to a study of the Moon's motions.   The first sketch of his new method was published in 1846; his *Théorie du Mouvement de la Lune* not till 1860 and 1867 (2 vols.).   He first suggested that an apparent secular acceleration of the Moon's mean motion may be due to a retardation

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of Earth's rotation. He was appointed Director of Paris Observatory in 1870, but was drowned soon after in a boating disaster off Cherbourg. **173 E g**

DELISLE. Joseph Nicolas Delisle, 1688–1768. (Schr)

First attracted to astronomy by the solar eclipse of 1706, and made observations of sunspots. In 1725 Catherine of Russia invited him to preside over the newly founded observatory of St Petersburg. On his return to Paris, in 1747, Lalande and Messier became his pupils and assistants. He suggested a method of determining the Sun's distance by transits of Mercury and Venus. **174 H c**

DELMOTTE. Gabriel Delmotte, 1876–   . (Lam)

Distinguished French selenographer, manufacturer, and deputy for the Nord. Discovered the "elliptic areas" and traced the directive system of Tycho in a systematic study of the types of lunar formation; presented numerous papers to the French Astronomical Society, received its Rey Prize and became secretary of its Committee for Lunar Studies, also President of the Association Astronomique du Nord and Vice-President of the Lunar Commission of the I.A.U. Publications include *Recherches Sélénographiques*, 1923. **175 B c**

DELUC. Jean André Deluc, 1727–1817. (M)

Swiss geologist and physicist, born in Geneva, author of French works on the atmosphere, the history of the Earth, and the elements of geology. He came to England, and died at Windsor. **176 F k**

DEMBOWSKI. Baron Ercole Dembowski, 1815–1881. (Kr)

One of the greatest double-star observers, he made over 20,000 observations of most of the Struve stars and many others at his private observatory, first at Naples, later at Milan: his work is notable for extreme accuracy. He published over seventy papers and received the gold medal of the Royal Astronomical Society: his complete work was published, with a biography, by Schiaparelli and O. Struve. **177 E e**

DEMOCRITUS. *c.* 460–*c.* 360 B.C. (R)

Greek philosopher of Abdera in Thrace, who adopted and developed the atomic theory of Leucippus, teaching that matter consists of minute indivisible indestructible bodies which combine and separate to form every variety of object. In astronomy he chiefly followed Anaxagoras, but was the first to explain the Milky Way as due to innumerable faint stars close together. He travelled far in pursuit of knowledge, and was surnamed "the Laughing Philosopher." **178 D a**

DEMONAX. Second century B.C. (Smt)

Greek philosopher, born in Cyprus but came to live in Athens. He joined the Cynics, but sympathized also with other schools of

thought, and was so much esteemed and beloved that when he died, at 100 years of age, his funeral was attended by the whole city. **179 E k**

DE MORGAN. Augustus de Morgan, 1806–1871. (B)

For thirty years professor of mathematics in University College, London. He was a great and clear teacher, and did much for the development of logic and for the introduction of the metric system. He was skilful in confuting believers in a flat Earth and other heresies, and his *Budget of Paradoxes* still provides entertaining reading. **180 D e**

DESCARTES. René Descartes, 1596–1650. (M)

Great French philosopher and mathematician, author of the theory that matter originates as vortices in the ether which fills all space. In his *Dioptrica* he explained the defects of early telescopes as mainly due to spherical aberration; and his advice to figure the lenses to a different curve or increase the focal length heralded the inordinately long but much improved telescopes of Huygens, Hevelius, and others. His books were all written in Holland, but he died in Sweden, where he went by invitation of Queen Christina. **181 D fg**

DESEILLIGNY. Jules Alfred Pierrot Deseilligny, 1868–1918. (Lam)

French selenographer, who presented numerous papers on individual formations and the origin of the surface features of Earth and Moon to the French Astronomical Society. At his instance the Society formed a lunar section, which he directed until his death, when the Society expressed the desire that his name should be commemorated on the Moon. **182 D d**

DE VICO. Francesco de Vico, 1805–1848. (N)

Italian astronomer, director from 1840 of the Collegio Romano Observatory. He made a series of observations of Venus, rediscovered Bianchini's dark spots, and thence determined a rotation period of $23^h 21^m$, and also confirmed the presence of high mountains. He discovered "De Vico's Comet," with a period of five and a half years, and five others. In 1848 he came to London, where he died. **183 K g**

DEVILLE. Sainte-Claire Charles Deville, 1814–1876. (B)

French geologist, born in the West Indies, who explored those islands and Fogo Island (off Newfoundland), Teneriffe, and South Italy, to study volcanoes and earthquake phenomena. He became the assistant and successor of Élie de Beaumont in the Collège de France, and established a chain of meteorological stations in France and Algeria. **184 E b**

DIONYSIUS. St. Dionysius the Areopagite, A.D. 9–120. (R)

Riccioli places him among the astronomers because of the legend that when he was in Heliopolis in Syria, he saw the miraculous darkness of the Crucifixion and knew it could not be caused by an eclipse; he was afterwards converted to the Christian faith, and died as a martyr when nearly 111 years old. (Dionysius Exiguus is also in Riccioli's lunar map and list, but the name did not survive.) **185 D e**

DIOPHANTUS. *c.* fourth century A.D. (M)

Eminent mathematician of Alexandria, perhaps not Greek, died at eighty-four years of age. His *Arithmetica* is really on algebra, and marks a noteworthy advance on any known older work, for he used algebraic symbols and gave rules for solving equations, simple, quadratic, and indeterminate. It was translated into Arabic in the tenth century, and so indirectly affected the progress of European mathematics. **186 H c**

DOERFFEL. Georg Samuel Doerffel, 1643–1688. (Schr)

Son of a German pastor of Plauen, he studied theology at Leipzig; met Weigel and Leibniz at Jena and took up mathematics and astronomy. He zealously followed his father's calling, yet found time for astronomy; and in 1681 published his observations of the 1680–1681 comet, concluding that it moved in a parabolic orbit with the Sun in the focus. This was afterwards proved theoretically by Newton, applying the law of gravitation. For this and other original work on comets, Schröter gave his name to the lunar mountain range. **F k**

In *N.L.F.* the name has one f only, but the above is more correct.

DOLLOND. John Dollond, 1706–1761. (Lo)

English optician, son of a Huguenot weaver, lived and died in London. He invented the achromatic lens (1758), and thus was able to make refracting telescopes free from colour aberration, yet of convenient length, thus superseding the unwieldy long refractors which had been popular for a hundred years. For this he received the Copley Medal of the Royal Society. His son, Peter Dollond (1730–1820), helped him in making his numerous excellent telescopes, and continued the work after his death. **188 D f**

DONATI. Giovanni Battista Donati, 1826–1873. (B)

Famous for his discovery in 1858 of the beautiful comet which bears his name, and six others. Comets were then thought to shine by reflected sunlight only, but Donati, applying the new science of spectrum analysis to Tempel's of 1864, discovered bright lines due to glowing gases. He was assistant, then director, of the Museum Observatory in Florence; but through his untiring efforts the National Observatory was established at Arcetri in 1872. **189 E g**

DOPPELMAYER. Johann Gabriel Doppelmayer, 1671–1750. (Schr)

Born in Nüremberg, and for nearly half a century professor of mathematics in his native town. He published many mathematical, geographical, and astronomical works, including a *Star Atlas* and a work on the Moon containing a coloured chart and description of her markings, following the nomenclature of Hevelius and Riccioli. **190 H h**

DOVE. Heinrich Wilhelm Dove, 1803–1879. (Smt)

German physicist, born at Liegnitz, and from 1829 professor in Berlin. He is noted for his researches in meteorology and electricity. **191 D j**

DRAPER. Henry Draper, 1837–1882. (Kr)

One of the pioneers in celestial photography and spectroscopy. He photographed the Moon in 1863, and later the spectra of stars; and he was the first to photograph the Orion Nebula, in 1880–1882. The Harvard catalogue of stellar spectra, introducing the new classification of stellar types, was published as a memorial to him, and is known as the *Draper Catalogue*. He was the son of Dr John Draper, who left England and settled in U.S.A. in 1833. **192 G d**

DREBBEL. Cornelius Drebbel, 1572–1634. (M)

Born in Alkmaar, was tutor to sons of Emperor Ferdinand II, taken prisoner by troops of the Elector Frederick, released on request of James I of England, went to his Court and was there held in high regard. He wrote *De Natura Elementarum* (on wind, thunder, etc.), and claimed to have invented the telescope and microscope. Possibly he improved the latter, for a letter to Mersenne from London (1648) mentions "les Microscopes à la façon de notre Drebbel." (*See* LIPPERSHEY, JANSEN, MERSENIUS.) **193 H j**

DUNTHORNE. Richard Dunthorne, 1711–1775. (Kr)

Born at Ramsey, Huntingdonshire. He assisted Long in his astronomical work; and as surveyor and engineer his drainage works in the east of England are notable. He did much work on the tables of the Moon, confirmed its secular acceleration and estimated the amount; also published researches on the orbits of Jupiter's satellites and on periodic comets. **194 H h**

References to the crater as "Dunthorst" are due to an error of Krieger, noted by König.

EGEDE. Hans Egede, 1686–1758. (M)

An eminent Danish missionary, who sailed to Greenland in 1721 with three ships, one of which was lost on the voyage. After preaching the Gospel there for fifteen years, and establishing several missionary stations on the west coast, he returned home, and published in Copenhagen a book on the *Natural History of Greenland*. **195 E b**

EICHSTADT. Lorentz Eichstadt, 1596–1660. (R)

Born at Stettin, where he was doctor of medicine, and observed a total eclipse of the Moon on March 3, 1635. Riccioli recorded his results and compared them with those of Gassendi at Marseilles, Crüger at Danzig, and Langrenus at Brussels. He became professor of mathematics at Danzig, and published ephemerides of planets, Sun, and Moon, and his calculations of eclipses. **196 K g**

EIMMART. Georg Christoph Eimmart, 1638–1705. (Schr)

An engraver on copper and amateur astronomer, author of a small lunar map, born in Regensburg and died in Nüremberg. Marie Claire, his daughter, worked with him and made for him a great number of astronomical drawings, including sunspots, comets, and eclipses. **197 A cd**

ELGER. Thomas Gwyn Elger, 1838–1897. (Kr)

Son of an architect in Bedford. After his college course he trained as an engineer, and took part in important railway constructions; but from about 1864 devoted himself chiefly to natural history, antiques, and astronomy. His early work as draughtsman helped him to make beautiful drawings of lunar regions, and many appeared in the publications of the Lunar Section of the B.A.A., of which he was the first director. In *The Moon*, with map (1895), he relied mainly on Beer and Mädler for positions, but the shapes and details of most formations are his own. **198 GH h**

ENCKE. Johann Franz Encke, 1791–1865. (M)

Son of a Hamburg pastor, he studied geometry under Gauss, fought in the Napoleonic wars, was assistant and successor to Lindenau at Seeberg Observatory, finally Director of Berlin Observatory in 1825. Under his direction the zodiacal star maps were compiled which enabled his assistant Galle to find Neptune without delay in the position calculated by Leverrier. He calculated the elements of "Encke's Comet" (1818), found that it had been seen previously by Caroline Herschel and others, and predicted its return: it was the first short-period comet to be recognized. He also contributed to the lunar theory. **199 H e**

ENDYMION. (R)

In Greek legend a youthful shepherd whose beauty, as he lay sleeping on Mt Latmos, so fired the cold heart of Selene (the Moon) that she came down and kissed him, and he slept on for ever. **200 C ab**

EPIDIARUM, Palus. Marsh of Epidemics. (Smt) **201 H h**

EPIGENES. Third century B.C.? (R)

A Greek astronomer of Byzantium, of uncertain date, who is mentioned by Pliny and Seneca as having studied astronomy in

Chaldea. He is said to have brought to Greece an account of bricks on which the Chaldeans had inscribed observations extending over a vast number of years, also he reported that they believed comets to be of atmospheric origin. **202 F a**

EPIMENIDES. Fl. 596 B.C. (Smt)

A poet and prophet of Crete, born in Phaestos and spent most of his life in Knossos. He visited Athens in 596 B.C., and was by some counted among the seven sages of Greece. St Paul quotes him, though not by name, in his Epistle to Titus in Crete. **203 G j**

ERATOSTHENES. *c.* 276–*c.* 196 B.C. (R)

One of the great Greek pioneers in science, especially astronomy and geography, and custodian of the great library in Alexandria. He was the first to measure the circumference of the Earth, by observing the zenith distance of the Sun at Alexandria when it was overhead at Syene and comparing the distance in stadia between the two places. His result seems to have been about 24,662 miles. He also measured the obliquity of the ecliptic with an error of only 7′. **204 FG d**

EUCLIDES. Euclid, *c.* 300 B.C. (R)

The celebrated Greek mathematician whose name has for centuries been almost synonymous with Geometry. He founded the mathematical school in Alexandria, where he lived, and he also wrote on astronomy; but the place of his birth is uncertain, and of his private history we know nothing. **205 H f**

EUCTEMON. Fl. 432 B.C. (R)

An astronomer of Athens, of whom we know nothing except that with Meton he invented the calendar which is still the basis of the present ecclesiastical system for fixing Easter, and discovered that the seasons are of unequal length. **206 E a**

EUDOXUS. *c.* 408–*c.* 355 B.C. (R)

Celebrated Greek astronomer, who studied under Plato and at Heliopolis in Egypt, then worked in his observatory at Cnidos, "a little higher than the houses of the town" (Strabo says). He was a skilled geometer, and invented an ingenious system of concentric spheres rotating round the central Earth to represent the movements of the heavenly bodies so far as known to him. He also wrote a book describing the constellations. (*See* ARATUS.) **207 DE b**

EULER. Leonhard Euler, 1707–1783. (Schr)

Swiss mathematician whose name is perpetuated in several formulæ. He was born at Basle, and educated there under Jean Bernouilli; was professor of mathematics in St Petersburg, then in Berlin, but returned to St Petersburg. He gradually became blind, but carried on his calculations mentally. He wrote many valuable works on pure and applied mathematics: in astronomy the most

important were on the motions of planets and comets, and on the lunar theory. From the latter Mayer constructed his lunar tables. (*See* MAYER, T.). **208 H d**

FABRICIUS. David Goldschmidt, 1564–1617. (R)

A Frieslander, pastor of the little village Osteel in north Holland, and an amateur astronomer; visited Tycho and was a friend of Kepler. He could not afford to buy good instruments, but was an excellent observer, and discovered Mira, the first star to be recognized as a variable, in 1596 and 1609. His Latinized name, like the original, denotes a worker in metals, a goldsmith.

Johann Goldschmidt, his son (also better known as Fabricius), was one of the earliest observers of sunspots, and showed that their movements on the disc indicate a rotation of the Sun on its axis (1611). He is not, however, in Riccioli's list. **209 C j**

FARADAY. Michael Faraday, 1791–1867. (B)

Originally a bookbinder's apprentice, he was fired by Humphry Davy's lectures to study chemistry, and became his assistant, later professor of chemistry and director of the laboratory of the Royal Institution. His work and brilliant discoveries are famous, in physics, electricity, and magnetism. **210 E j**

FAUTH. Philipp Johann Heinrich Fauth, 1867– . (Mül)

Distinguished German selenographer, also a planetary observer. In 1890 he built his own observatory near Kaiserslautern, but since 1931 has lived and observed at Grünwald, near Munich. He has published many drawings in fine detail of special lunar features, and a series of *New Lunar Maps* (1932); also three books on the Moon, the latest of which, *Unser Mond* (1936), with Map in six sections, is a comprehensive summary of fifty-two years' work and a study of recent lunar problems. He is a zealous adherent of the glaciation theory. **211 G e**

FAYE. Hervé Faye, 1814–1902. (B)

Author of *Sur l'Origine du Monde*, an historical account of ancient and modern cosmogonies, and a suggested modification of that of Laplace. He was a pupil of Arago, and became astronomer in Paris Observatory, and member of the Bureau des Longitudes; but is chiefly remembered as writer and teacher, and the discoverer of "Faye's Comet" in 1843. **212 E g**

FERMAT. Pierre de Fermat, 1601–1665. (M)

Born near Montauban, the son of a leather merchant, he became councillor for the local parliament of Toulouse, and was distinguished for strict integrity, a scholar, linguist, and great mathematician, especially celebrated for his discoveries in the theory of numbers. "Fermat's Last Theorem" is famous, and has never been solved. **213 D g**

FERNELIUS.   Jean Fernel, 1497–1558.   (R)

French physician, author of *Cosmotheoria*, in which he describes the epicyclic system of the universe then still in vogue, and gives the result of a new determination he had made of the size of the Earth, the first since the time of Almamun in Baghdad.   (*See* ALMANON.) His error is less than 1 per cent., although his methods were rough. **214 E j**

FEUILLÉE.   Louis Feuillée, 1660–1732.   (Smt)

French Minorite monk, who was for twenty-one years Director of Marseilles Observatory.   He was sent by Government on a scientific expedition to South America, 1703–1706, where he saw a total solar eclipse, and determined many geographical positions, using the method of lunar distances for the longitudes.   He also studied the local flora, and after returning to France published his *Journal* of astronomical, botanical, and other observations.   **215 F c**

Spelt with one final é in *N.L.F.*, but the above seems to be more correct.

FIRMICUS.   Firmicus Maternus, *c.* A.D. 330.   (R)

A Sicilian living in the reign of Constantine, author of a work on astrology in eight books, which was much esteemed and widely used for many centuries.   However, when Gerard, Archbishop of York died in 1108, and this book was found under his pillow, the canons of York Cathedral were indignant and refused to bury him in cathedral precincts.   **216 A e**

FLAMMARION.   Camille Flammarion, 1842–1925.   (Gaud)

French astronomer who did much to popularize astronomy.   He was apprenticed to an engraver in Paris, but his enthusiasm for astronomy becoming known, he was appointed computer in Paris Observatory and later in the Bureau des Longitudes.   His books and lectures brought him many friends, and he was given a house and garden in Juvisy, where he observed planets and stars.   He founded the Société Astronomique de France; and it was while writing for its bulletin, *L'Astronomie*, that he died.   **217 F f**

FLAMSTEED.   John Flamsteed, 1646–1720.   (M)

Born at Denby, in Derbyshire, and early took an interest in astronomy, catalogued seventy stars, and computed data for the 1666 solar eclipse.   His prediction of lunar occultations due in 1670 brought him into notice: when Greenwich Observatory was built he was the first Astronomer Royal, and Newton applied to him for lunar observations.   His *Star Catalogue* was the first since Tycho's, and much fuller and more accurate.   The "Flamsteed numbers" marked in his *Star Atlas* in addition to Bayer's Greek letters are still in use.   **218 J f**

FOECUNDITATIS, Mare.   Sea of Plenty or Fertility.   (R)   219 B f

FONTANA. Francesco Fontana, *c.* 1585–1656. (R)

A Neapolitan lawyer and amateur astronomer, who was one of the first to make and use telescopes after the invention in 1608, and to see the belts of Jupiter. He was an enthusiastic planetary observer, saw the phases of Venus and the 1645 transit of Mercury, and noted a spot on Mars (perhaps only an optical effect) and guessed from its changes that the planet rotates on its axis. **220 J g**

FONTENELLE. Bernard le Bovier de Fontenelle, 1657–1757. (Schr)

Born at Rouen, but lived chiefly in Paris. He was one of the first members of the Académie des Sciences, of which he was secretary, 1699–1741. He wrote *Pluralité des Mondes* and other works of popular astronomy, and is an important source of information for the history of seventeenth-century science in France. **221 F a**

FOUCAULT. Léon Foucault, 1819–1868. (B)

Born in Paris, son of a well-known publisher, and trained as a doctor, but gave up medicine for physics, and is famous for his demonstration of Earth's daily motion by the rotating plane of oscillation of a pendulum. He also invented the gyroscope (1852), measured the velocity of light in air and in water, invented the knife-edge test for curvature in a mirror, and made some of the earliest silvered-glass mirrors for French observatories. **222 GH b**

FOURIER. Jean-Baptiste Joseph Fourier, 1768–1830. (M)

Son of a tailor in Auxerre, he became at eighteen teacher in a military school; played an active part in the Revolution; and served under Napoleon in Egypt. Afterwards he was made prefect at Grenoble, and there carried out his researches on heat. His chief work is the monumental *Théorie Analytique de la Chaleur*, and mathematicians are familiar with "Fourier's Series." **223 J h**

FRACASTOR. Girolamo Fracastoro, 1483–1553. (R)

Physician, astronomer, and Latin verse writer of Verona. At nineteen he was professor of logic at Padua; later he returned home and observed comets, noting their tails always pointing away from the Sun; experimented with lenses but failed to invent the telescope; and wrote on astronomy. His *Homocentrica* was an effort to supersede Ptolemy by a cumbersome system based on Eudoxus' concentric spheres, and was dedicated to the Pope, who a few years later received the work of Copernicus. **224 C g**

FRA MAURO. *d.* 1459. (M)

Venetian geographer, belonging to the Order of the Camaldulenses, and living in the monastery of San Michele, near Naples. In 1457 he completed a map of the world, which hangs since 1910 in the Doge's Palace in Venice. **225 G f**

FRANKLIN. Benjamin Franklin, 1706–1790. (M)

American statesman and diplomatist who played a prominent part in the War of Independence. In science he is specially remembered for his demonstration of the identity of lightning with electric discharge in the laboratory, and his invention of the lightning conductor. He was born in Boston, U.S.A., of poor parents, and was almost entirely self-educated. **226 C b**

FRANZ. Julius Heinrich Franz. 1847–1913. (Mül)

Assistant at Neufchatel and Königsberg, then Director of Breslau Observatory. His principal work was on the figure and libration of the Moon. His positions of limb formations from photographs and heliometer measures are employed in the Atlas of *Named Lunar Formations* of the I.A.U. He published *Die Randlandschaften des Mondes* and a small popular book *Der Mond.* **227 B d**

FRAUNHOFER. Joseph von Fraunhofer, 1787–1826. (M)

An orphan boy, apprentice to a glazier, he narrowly escaped death from the collapse of an old house in Munich in which he lived. The Elector of Bavaria saw this, and gave him eighteen ducats, with which he set up as an optical worker, became famous for his achromatic lenses, and made the Dorpat reflector for Struve (then the largest in the world), and the Königsberg heliometer. He invented the diffraction grating, discovered independently from Wollaston the "Fraunhofer lines" in the solar spectrum and mapped 324, in 1814; also examined the spectra of Moon, planets, and many stars. **228 B j**

FRESNEL. Augustin Jean Fresnel, 1788–1827. (Smt)

French physicist and civil engineer. He won renown in Paris for his optical researches and inventions, and was elected member of the Académie des Sciences in 1823. He studied aberration and polarization of light, and introduced the use of compound lenses instead of mirrors for lighthouses. **229 E c**

FRIGORIS, Mare. Sea of Cold. (R)

Near the North Pole. **230 DEFG a**

FURNERIUS. Georges Furner, fl. 1643. (R)

A French Jesuit, professor of mathematics in Paris, who published valuable work on hydrography in 1643. He corresponded with Riccioli on eclipses. **231 B hj**

GALILAEI. Galileo Galilei, 1564–1642. (R)

His discoveries and arguments secured the triumph of the Copernican system, although he was compelled to deny Earth's motion round the Sun, and was interned in his villa near Florence, where he died. While a student at Pisa, he had discovered the law of pendulum vibration, and later he demonstrated the action of gravity. Hearing

of Lippershey's invention, he made telescopes, and saw Jupiter's satellites, star clusters, sunspots, and the phases of Venus, made drawings of the Moon, and measured the heights of some of her mountains. **232 K e**

GALLE. Johann Gottfried Galle, 1812–1910. (Smt)

It is chiefly as the finder of Neptune in the Berlin Observatory telescope on the night of receiving Leverrier's calculated position that Galle is remembered; but he did valuable work on meteors and comets, and was the first to see, vaguely, Saturn's crape ring in 1838. When Director of Breslau Observatory (1851–1897) he suggested and used the method of finding the Sun's parallax by observations of the asteroids. Flora, in 1873, gave him a value of 88″·87. **233 D a**

GALVANI. Luigi Galvani, 1737–1798. (Smt)

Italian physicist from whom galvanism derived its name. He was born and died in Bologna; in 1762 was appointed professor of medicine there, and gained repute as a comparative anatomist; in 1791 published his theory of animal electricity. **234 J b**

GAMBART. Jean Félix Gambart, 1800–1836. (M)

His career began in the French Navy, but he took up astronomy, studied under Bouvard, and when only twenty-two years old became Director of Marseilles Observatory. In his short life he discovered thirteen comets, and worked out the orbit of Biela's, finding, simultaneously with its first discoverer, that it was identical with a comet seen in 1772 and 1805, and that its period was between six and seven years. It was the second short-period comet discovered. **235 G e**

GÄRTNER. Christian Gärtner, c. 1750–1813. (Schr)

German mineralogist and geologist, born in Brunswick. He trained as a goldsmith, and was living in Klaustal (Harz Mountains) in 1784, but later was mine surveyor in Thüringen. Little is known of his life, but his scientific works are on Ores, real and false, on the geology and topography of the German Mittelgebirge, and Bohemian Garnets. He died at Freiberg in Saxony, during the siege by Napoleon's troops. **236 D a**

Schröter gives the full name, and remarks that the region is of special interest to geologists because of resemblance to terrestrial regions, so this identification appears to be correct.

GASSENDI. Pierre Gassendi, 1592–1655. (R)

A Provençal, like his friend Peiresc, and associated with him in scientific and literary pursuits. He corresponded with Riccioli, upholding the Copernican system, also with Kepler and Galileo. He was professor of theology in Aix, later of mathematics in Paris, lectured and wrote on astronomy, mapped the Moon, and was the

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first to see and describe a transit of Mercury, that of 1631, foretold by Kepler.   **237 HJ g**

GAUDIBERT.   Casimir Marie Gaudibert, 1823–1901.   (Kr)

French amateur astronomer.   He was pastor of the Reformed Church at Vaison, Vaucluse; there he constructed his own telescope and observatory, devoting himself almost entirely to visual observation of the Moon.   In addition to numerous papers in *L'Astronomie* and the *English Mechanic*, he published a two-foot map of the Moon and a lunar globe.   He was a founder-member of the French Astronomical Society.   **238 BC f**

GAURICUS.   Luca Gaurico, 1476–1558.   (R)

Born at Giffoni near Naples, and studied at Ferrara, Venice, and Rome.   In 1545 he was ordained Bishop of Civita-Ducale, but after four years resigned office and returning to Rome devoted himself entirely to study.   He translated Ptolemy's *Almagest*, corrected the *Alphonsine Tables*, calculated ephemerides, and wrote on astrology, in which he had gained a reputation by some successful prophecies of war and famine.   **239 F h**

GAUSS.   Karl Friedrich Gauss, 1777–1855.   (M)

Son of a bricklayer in Brunswick, and became one of the greatest mathematicians of his time.   At school he already showed such promise that the Duke of Brunswick secured his further education. When Ceres was found and lost again by Piazzi he computed its position by a new method.   He was Director of Göttingen Observatory (built under his supervision); and with Weber he erected a magnetic observatory, and invented the magnetometer.   His name is used for the unit of magnetism.   **240 B bc**

GAY-LUSSAC.   Joseph Louis Gay-Lussac, 1778–1850.   (M)

Professor of physics at the Sorbonne, later of chemistry at the Jardin des Plantes, Paris, and member of the Académie des Sciences. He investigated the phenomena of hygrometry and capillarity; discovered the law of gaseous combination by volumes; and invented new methods for various industrial processes.   He was born at St-Léonard, in Haute Vienne, which he represented several times in the Chamber of Deputies, until he became a peer in 1839.   **241 G d**

GEBER.   Gabir ben Aflah, died *c.* 1145.   (R)

Spanish-Arab astronomer, living at Seville, who made important advances in spherical trigonometry, and wrote a book on astronomy in which he endeavoured to improve on the Ptolemaic system and described a kind of armillary sphere invented by himself for measuring positions of the heavenly bodies with regard to the meridian, equator, or ecliptic.   This was translated into Latin by Gerard of Cremona, and printed at Nüremberg in 1534; it was useful to Purbach and Regiomontanus, Sacrobosco, and many others.   **242 D g**

GEMINUS, *c.* 70 B.C. (R)

Greek astronomer, probably a native of Rhodes. He wrote an *Introduction to Astronomy*, chiefly based on the work of Posidonius, in which he describes simply the apparent movements of the heavens, and explains the lunar phases and eclipses of Sun and Moon. His work is historically important, especially for the information it gives concerning the successive calendars and cycles invented in Egypt and by the Greeks. **243 B c**

GEMMA FRISIUS. Reinier Jemma, 1508–1555. (R)

Founder of the Netherlands school of geography. Born in Friesland (hence his Latin surname), educated at Groningen, he became professor of medicine in Louvain and lectured on mathematics and astronomy. He was an author of mathematical and cosmographical books, a globe-maker, cartographer, and designer of astronomical instruments; but his fame rests chiefly on his invention of two new methods of fundamental importance in navigation and surveying, the determination of longitudes at sea by carrying timepieces (*De Usi Globi*, 1530), and mapping by triangulation (1533). Apian was his teacher, Mercator his pupil. **244 DE h**

GERARD. Alexander Gerard, 1792–1839. (M)

Himalayan explorer, born in Aberdeen, where his father and grandfather were professors. He entered the Indian survey service, penetrated to the Tibetan frontier, and explored unknown passes and peaks, reaching 22,000 ft. His work attracted the interest of Colebrooke, with whose assistance he published a memoir giving the first accurate information on the geological structure of the Himalayas. His brothers, James and Patrick, made important contributions to Indian geography and meteorology. The work of the brothers Gerard was brought to the notice of German scientists by Ritter (*Erdkunde von Asien*), whence no doubt Mädler's interest. **245 J b**

Clearly this is the man intended. Others suggested have been Gerard of Cremona, *d.* 1187; John Gerard, English botanist, *d.* 1612; Gerard of Sabionetta, thirteenth century; and, as the name is sometimes written with a French accent, Jules Gérard, "le Tueur des Lions," but he was only twenty when the name was applied.

GIOJA. Flavio Gioja. Fl. 1302. (M)

Italian sea-captain, born at Positano near Amalfi, who in 1302 invented the mariner's compass, giving to the floating magnetic needle pointing north (known in Europe for about a century) the convenient box and compass-card which ensured its general use at sea. The French fleur-de-lys, still often figured on our compass, was introduced by him to honour the reigning Angevin king of Naples. The captain's name was aptly given to a crater very near the North Pole of the Moon. **246 EF a**

GLAISHER. James Glaisher, 1809–1903. (Lee)

Pioneer of modern meteorology, founder of the Royal Meteorological Society, and first superintendent of the Magnetic and Meteorological Department, Greenwich Observatory. Birt says his name was placed on the lunar map by Lee in honour of his scientific balloon ascents with Coxwell, whose name is sometimes applied to lunar mountains near by. He also worked in terrestrial radiation. Both he and his son, J. W. L. Glaisher, the distinguished mathematician, were closely associated with the Royal Astronomical Society. **247 B d**

N.L.F. attributes the name to Birt, but he adopted it from Dr Lee.

GOCLENIUS. Rudolf Gockel, 1572–1621. (R)

German doctor; professor of physics, medicine, and finally of mathematics, at the University of Marburg. He wrote on mathematics, magnetism, astronomy, and astrology, publishing his *Urania* in 1615. His father, with the same name, was professor of rhetoric at the same university. **248 B f**

GODIN. Louis Godin, 1704–1760. (Schr)

Chief of the French geodetic expedition to Peru in 1735 (*see* CONDAMINE). He remained so long in Lima, having accepted a post as professor of mathematics, that it was thought he had died there. After his return to France, he went to Spain and was appointed Director of the Naval School for Cadets in Cadiz. He wrote on nautical and astronomical subjects, and a history of the Académie des Sciences from 1680 to 1699. **249 E e**

GOLDSCHMIDT. Hermann Goldschmidt, 1802–1866. (Lee)

Born at Frankfort-am-Main; of delicate health when young he abandoned a commercial career, took up painting, and became celebrated for historical subjects. Attracted to astronomy by Leverrier's lecture and an eclipse of the Moon the same evening, he purchased a small telescope by selling a portrait of Galileo! Observing from the windows of his studio he discovered fourteen asteroids in nine years with apertures never exceeding four inches. Also observed a solar eclipse, variable stars, nebulæ; and made a series of paintings of Donati's comet. Received the Legion of Honour and R.A.S. Gold Medal. **250 EF a**

N.L.F. attributes the name to Birt, but Birt writes: "named by the late Dr Lee."

GOODACRE. Walter Goodacre, 1856–1938. (Wil)

Author of a sixty-inch Map of the Moon (1910), the first to be based on modern accurate measures, those of Saunders. From childhood he was interested in astronomy, and has studied the Moon with telescopes of apertures from three to eighteen inches. He was Director of the Lunar Section, first of the Liverpool Astronomical Society and then of the British Astronomical Association, and was

president of the latter in 1922–1924. In 1931 he published his book *The Moon*. **251 DE h**

GOULD. Benjamin Apthorp Gould, 1824–1896. (Kr)

American astronomer, founder of the *Astronomical Journal*. First to use the transatlantic cable to make a longitude comparison between Europe and America. Organized Dudley Observatory, and later Cordoba Observatory, where he did his greatest work: the *Uranometria Argentina*, *Southern Zones*, and *General Catalogue*. His work on star clusters, especially in the southern hemisphere, was of great importance. **252 G g**

GRIMALDI. Francesco Maria Grimaldi, 1618–1663. (R)

Born and died in Bologna, where he was professor of mathematics and a Jesuit, of an illustrious family which gave eighteen bishops and seven cardinals to the Church. He discovered the diffraction of light, and was one of the first to suggest its undulatory nature. He was an accomplished observer, especially of the Moon, and wrote *Selenographia* and *De Lumine, Coloribus, et Iride*. His lunar map, drawn from his own and others' observations, was published by Riccioli, who gave names to all the formations shown therein. The two friends are represented by a pair of craters close to the east limb. (*See* Riccioli, Sirsalis.) **253 K f**

GROVE. Sir William Robert Grove, 1811–1896. (B)

A lawyer by profession who pursued scientific studies in his leisure time, and invented the platinum-zinc voltaic cell known by his name. He was the first to use incandescent electric lamps. His great work is the *Correlation of Physical Forces*. He was born in Swansea and died in London. **254 C b**

Though correctly spelt in the text and index of Neison's *The Moon*, the name is given as "Groves" in his Map, and this error has been followed in later lists, including that of *N.L.F.*

GRUEMBERGER. Christoph Grienberger, 1561–1636. (R)

Born in Hall (Austrian Tyrol), he came to Rome, where he was pupil and successor of Clavius as professor of mathematics; and in the palace built by Gregory XIII as a centre of study for the Jesuits he improved astrolabes and sundials, made a catalogue of stars, comparing old and new estimates of their positions, and invented the equatorial mounting for telescopes. His character was lovable, according to Riccioli, who gave him a crater near the large one assigned to Clavius. **255 F k**

N.L.F. gives Schröter as authority, relying on Neison, but Gruemberger is in Riccioli's lunar list and map.

GRUITHEISEN. Franz von Gruitheisen, 1774–1852. (N)

Born in Castle Haltenberg, on the River Lech in Bavaria, and took a medical degree in Landshut University. Becoming interested

in astronomy, he observed Venus, saw dark shadings and two white spots which he took to be polar snow-caps. In 1826 he was appointed professor of astronomy in Munich. He was an assiduous lunar observer, but fanciful, and wrote a book describing his discovery of splendid buildings and other evidences of lunar inhabitants. **256 H c**

GUERICKE. Otto von Guericke, 1602–1686. (M)

Born at Magdeburg, and when it was sacked in the Thirty Years' War nearly lost his life, but returned to help to rebuild and fortify it, and became its burgomaster. He was a pioneer in pneumatics, invented a water-barometer and several forms of air-pumps, and in 1654 demonstrated air pressure by his hollow bronze "Magdeburg Hemispheres." These being fitted together and emptied of air, two teams of eight horses could not drag them apart. He also proved that sound is transmitted by air, and made an electrical machine. **257 G fg**

GUTENBERG. Johann Gutenberg, *c.* 1398–1468. (M)

Inventor of printing with movable types. He was born at Mainz, and spent most of his life there; but in 1434 was in Strasbourg, teaching stone-cutting and mirror-polishing. About 1450 he entered into partnership with Fust, a goldsmith, who supplied the money for setting up a printing-press in Mainz. Later the partnership was dissolved, and Gutenberg suffered from financial difficulties, but he was pensioned by Duke Adolf of Nassau, and enabled to set up another printing-press, at which he worked until his death. **258 B f**

GYLDEN. Hugo Gyldén, 1841–1896. (Kr)

Born at Helsinki (Helsingfors), he held posts there and at Pulkovo, and became Director of Stockholm Observatory. His work on orbit theory is of permanent importance. He devised new methods in perturbation work, and his later work on the absolute orbits of the planets is of extreme originality. He also worked on the rotation of the Earth, refraction theory, and other problems. **259 E f**

HADLEY. John Hadley, 1682–1743. (Schr)

Maker of the first really satisfactory reflecting telescope, with a metallic mirror of six inches aperture and focal length six feet, approved by the Royal Society in 1723. This was followed by "Hadley's Reflecting Quadrant" in 1731, which replaced the astrolabe and cross-staff in navigation, and is still used everywhere. Hadley was a friend of Bradley, who became Astronomer Royal, and it was largely through their joint efforts that reflecting telescopes came into general use. **260 E c**

HAEMUS, Mts. (M)

Ancient name of the Balkan Mts, first given by Hevelius: "Haemus, mons Thraciae." **DE d**

HAGECIUS. Thaddaeus Hayek, 1525–1600. (R)

Born in Prague, studied mathematics and astronomy, and became librarian to the Emperor Maximilian through his knowledge of old Bohemian manuscripts. Also studied in Vienna, Bologna, and Milan. Returning to Prague, he was appointed physician to the Emperor, and was often called in consultation to foreign countries. In 1575 he met Tycho: they corresponded, and Hagecius recommended his method of meridian observation. His chief works were on geometry, comets, and the New Star of 1572. It was on his advice that Tycho was invited to Prague. **262 D k**

HAHN. Friedrich, Graf von Hahn, 1741–1805. (M)

A well-known amateur astronomer, who built an observatory at his country seat of Remplin, near Mecklenburg, and made and published many observations on sunspots, Jupiter's belts, variable stars, and others. His notes on the physical features of the Moon appeared in the Berlin *Astronomisches Jahrbuch*. **263 A c**

HAIDINGER. Wilhelm Karl von Haidinger, 1795–1871. (Smt)

Austrian geologist and physicist, born in Vienna, son of an eminent mineralogist, Karl Haidinger. He was for seventeen years director of the Imperial Geological Institute of Vienna, and organized the Society of the "Freunde der Naturwissenschaften." He was knighted in 1865, and died at Darnbach, near Vienna. **264 G j**

HAINZEL. Paul Hainzel, fl. 1570. (R)

When Tycho visited Augsburg in 1569, he met the brothers Hainzel, Johann the burgomaster and Paul an alderman. They discussed astronomy, and wished to have a good instrument at their country seat at Göggingen; so Tycho directed the making of a nineteen-foot quadrant of oak and brass, which twenty men erected on a hill in the garden. Paul's observations, especially of the New Star, were used by Tycho at Hveen, and they frequently corresponded. **265 GH j**

HALL. Asaph Hall, 1829–1907. (Kr)

Born in Connecticut, studied at Michigan Observatory, and held chairs at U.S. Naval Observatory and at Harvard. One of the foremost observers of his time, celebrated for discovering the satellites of Mars. Other important work included research on double stars, especially the companion to Sirius, the diameters of the great planets, the motions of the fainter satellites, the rotation of Saturn, solar parallax by Mars, and many mathematical topics. **266 C c**

HALLEY. Edmund Halley, 1656–1742. (B)

A student of astronomy while still at school, at nineteen he published a paper on planetary orbits, and in the same year went to St Helena to catalogue the southern stars. He was a friend of

Newton, and persuaded and helped him to publish the *Principia*.   He contributed to astronomy in many ways, suggested what is now known as the secular acceleration of the Moon's mean motion, and was the first to predict the return of a comet—"Halley's Comet" of 1682.   He succeeded Flamsteed as Astronomer Royal.   **267 E f**

HANNO. *c.* 500 B.C.   (M)

A Carthaginian navigator who undertook a very early and daring voyage beyond the Pillars of Hercules (Straits of Gibraltar) down the West African coast, to explore and colonize.   On his return he wrote an account in the Punic language, and a Greek *Periplus* now extant is believed to be a translation of this.   **268 C k**

HANSEN. Peter Andreas Hansen, 1795–1874.   (M)

Born at Tönder, Schleswig, and originally a watchmaker, he was employed in the Danish Survey 1821–1825, and then appointed Director of Seeberg Observatory (Gotha).   His work on the perturbations of planets (1830) and of comets (1850) won prizes from Berlin and Paris Academies; and the tables based on his lunar theory were adopted for the *Nautical Almanac* (1857).   He derived a solar parallax from the lunar parallactic inequality, and showed that the hitherto accepted distance of the Sun was too great.   **269 A d**

HANSTEEN. Christopher Hansteen, 1784–1873.   (M)

Born in Christiania (Oslo), he taught at a school in Zeeland, then from 1815 was Director of Christiania Observatory, to which he added a magnetic department.   He travelled to Siberia with Erman to investigate terrestrial magnetism, and discovered the position of the magnetic north pole; and he superintended the trigonometrical survey of Norway begun in 1837.   He wrote on magnetism and electricity, the aurora, meteor showers, and the corona seen at an eclipse in 1851.   **270 J fg**

N.L.F. gives Riccioli as authority in error.

HARBINGER, Mts. Harbingers of dawn on Aristarchus.   (B)

(*See* Webb's *Celestial Objects*, p. 112.)   **271 H J c**

HARDING. Karl Ludwig Harding, 1765–1834.   (M)

Born in Lauenburg, he was destined for the Church, but as tutor of Schröter's sons fell in love with astronomy, and became assistant at Schröter's observatory.   He discovered the asteroid Juno in 1804, and next year was appointed professor of astronomy at Göttingen.   His *Atlas novus coelestis* (1822) was much the best of the whole sky visible in Europe until excelled by Argelander's.   He observed variable stars, discovered eight new nebulæ, and saw Saturn's rings disappear in 1833.   **272 J b**

HARPALUS. *c.* 460 B.C. (R)

Greek astronomer of whom we know only that he suggested improvements in the octaeteris, or eight-year luni-solar cycle of Cleostratus. He must therefore have lived after Cleostratus (*c.* 500 B.C.), but before Meton (*c.* 432 B.C.), whose nineteen-year cycle superseded the octaeteris. **273 H b**

HASE. Johann Matthias Hase, 1684–1742. (Schr)

Born at Augsburg, and was appointed professor of mathematics at Wittenberg University in 1720. He wrote on algebra, and on the eclipses of 1726. In his day he was famous for his terrestrial maps, which were collected and published posthumously under the title *Historischer Atlas*, Nüremberg, 1750. He died in Wittenberg. **274 B h**

HAUSEN. Christian August Hausen, 1693–1743. (Schr)

Astronomer, mathematician, and physicist, born at Dresden and became professor of mathematics at the University of Leipzig, where he died. His publications include works on the rotation of the Sun, electricity, and mathematics. **275 H k**

HECATAEUS. *d.* about 476 B.C. (M)

The first of the great Greek geographers. After visiting Egypt and many other countries he returned to his native city of Miletus, where he held a high position, and wrote a book describing the countries and inhabitants of the known world. It was accompanied by a Map of the Earth, based on Anaximander's, but corrected and enlarged. **276 A gh**

HEINSIUS. Gottfried Heinsius, 1709–1769. (Schr)

German astronomer born at Naumberg-on-Saale. He was for seven years professor of astronomy at St Petersburg, where he watched Saturn's rings become invisible in 1743, and made excellent observations of the great comet of 1744. He then was professor of mathematics at Leipzig, and deduced its longitude from a lunar eclipse. He wrote on lunar occultations of stars, the rings of Saturn, and the solar eclipse of April 1764. **277 G j**

HEIS. Eduard Heis, 1806–1877. (Smt)

Born·at Cologne and educated at Bonn University. He studied astronomy under Argelander, and his exceptionally good eyesight enabled him to do valuable observational work, especially on variable stars. His *Atlas Coelestis Novus* (1872) continued to be the most popular of its kind well into the twentieth century. **278 H c**

HELICON. Fourth century B.C. (R)

Greek mathematician and astronomer of Cyzicus. He was at some time at the Court of Dionysius, tyrant of Syracuse, among the

many learned men attracted thither, for he is said to have received a talent of silver from Dionysius as reward for foretelling an eclipse of the Sun. According to Plutarch, Plato said of a baffling mathematical problem that only two men were capable of solving it, Eudoxus and Helicon. **279 G b**

HELL. Maximilian Hell, 1720–1792. (Schr)

Born in Schemnitz (Hungary), he entered the Order of Jesuits, and was well known as Father Hell, Director of Vienna Observatory, who published the *Ephemerides Astronomicae* from 1756, and discussed the supposed discovery of a satellite to Venus, though he was never convinced of its existence. He spent the winter of 1768 studying terrestrial magnetism in Lapland, and in 1769 observed the transit of Venus there. He was one of the first to use Horrebow's method of determining the altitude of the Pole. **280 F h**

HELMHOLTZ. Hermann von Helmholtz, 1821–1894. (Smt)

Physician and surgeon; professor of physiology successively at Königsberg, Bonn, and Heidelberg universities; later, of physics in Berlin. He invented the ophthalmoscope (1851), and wrote an important work on the physiology and physics of vision. He helped to establish the law of conservation of energy, and was the first to propound the hypothesis (1854) that the Sun's heat was maintained by gradual contraction of its volume. **281 D k**

HENRY, FRÈRES. Paul Henry, 1848–1905, and Prosper Henry, 1849–1903. (Gaud)

Born at Nancy, the brothers Henry entered Paris Observatory in meteorology, and later charted 50,000 ecliptic zone stars, discovering fourteen asteroids. They were expert planetary observers, but are principally known as pioneers of astronomical photography and for their optical work; the latter included the design of the standard astrographic instrument, the great Meudon refractor, and the twenty-four-inch coudé used for the Paris Atlas of the Moon. **282 J h**

HERACLIDES. Heraclides Ponticus, *c.* 388–*c.* 310 B.C. (R)

Born in Pontus, went to Athens, and was a pupil of Plato, perhaps of Aristotle also, and studied the teachings of the Pythagoreans. In 338 he returned to his native city. His dialogue *On the Heavens* and many others are all lost; but later authors assert that he taught that Earth rotates on her axis in twenty-four hours, thus causing the apparent daily movements of the heavens, also that Venus and Mercury circle round the Sun. **283 H b**

HERACLITUS, *c.* 540–*c.* 480 B.C. (R)

Greek philosopher of Ephesus, whose teaching that all things are in a constant state of change and conflict won for him the name of "weeping philosopher." He thought exhalations from Earth

became celestial fire in the cup-shaped forms of Sun, Moon, and stars, and that the phases of the Moon were due to turnings of the lunar cup, its convex side being turned towards us at New Moon and eclipse. **284 E j**

HERCULES. (R)

Mythical hero of superhuman strength in Greek and Latin mythology, who relieved Atlas of the burden of the heavens and bore them on his own shoulder while the apples of the Hesperides were brought to him. Riccioli considered that he was really a famous astronomer, living about 1560 B.C., and gave the two names to a twin pair of craters on the Moon. **285 C b**

HERCYNIAN Mts. (M)

Ancient name of Thüringer Wald Mts. **286 K c**

HERIGONIUS. Pierre Herigone, fl. 1644. (R)

French mathematician who lived in Paris, but of whom very little is known. His *Cursus Mathematicus* in six volumes was published in Paris in 1644. The fourth volume deals with the celestial sphere and geographical maps, and the fifth with the theory of the planets. **287 H g**

HERMANN. Jacob Hermann, 1678–1733. (Schr)

Swiss mathematician born at Basle. He was a pupil of Jacques Bernouilli, and was appointed professor of mathematics successively at Padua, Frankfort-on-the-Oder, St Petersburg; finally professor of moral philosophy at Basle, where he died. He wrote a number of papers on mathematical and astronomical subjects, including re-fraction of light, gravitation, and planetary orbits. This is evidently the man intended by Schröter (who also named Bernouilli), for he gives the prenomen Jacob. **288 K f**

HERODOTUS. *c.* 484–*c.* 408 B.C. (R)

Greek historian, the "Father of History." He was the first who carefully collected his materials, tested their truth as far as he could, and presented them as an epic story, written in clear beautiful prose. He was born in Halicarnassus (Asia Minor), travelled far and wide, visiting sites of important past events, and recited his history in Athens, Olympia, Corinth, and other Greek cities. **289 J d**

HERSCHEL. William Herschel, 1738–1822. (Lo)

Born in Hanover and trained as oboe-player in a military band; came to England and became organist and director of concerts at Bath; began to make and use telescopes, and discovered Uranus; thereupon was appointed astronomer to George III, and moved to Slough. With his powerful telescopes he swept the heavens and inaugurated sidereal astronomy. He investigated the distribution of stars and

form of the Galaxy; discovered that stars and Sun have proper motions, and that many doubles are true binaries; that some of the 2500 nebulæ he discovered were resolvable into stars and might be external galaxies, while others seemed to consist of a "shining fluid." **290 F f**

HERSCHEL, Car.   Caroline Herschel, 1750–1848.   (B)

Sister of William Herschel, and went to him from Hanover to Bath, to be his housekeeper and companion; and for fifty years shared devotedly in all his work.   She discovered eight comets, and many of the smaller nebulæ and star clusters included in his catalogue.   When he died she returned to Hanover.   She was made an honorary member of the Royal Astronomical Society.   **291 H c**

HERSCHEL, J.   John Herschel, 1792–1871.   (B)

Only child of William Herschel, born at Slough.   He continued his father's sidereal work, especially in his great survey of the southern hemisphere at the Cape of Good Hope, 1834–1838, and published the *Results* in a fine volume with sub-title *The Completion of a Telescopic Survey of the Whole Surface of the Visible Heavens*.   His *Outlines of Astronomy* was translated into Chinese and Arabic and most European languages.   **292 G a**

HESIODUS.   Hesiod, *c.* 735 B.C.   (M)

One of the earliest Greek poets after Homer, born and lived in Bœotia.   In his *Works and Days*, which describes peasant life in his country, he fixes dates for agricultural operations by the times when constellations become visible before sunrise or are last seen just after sunset.   **293 G h**

HEVELIUS.   John Hewelcke or Hevel.   1611–1687.   (R)

Born, lived, and died in Danzig, where he was Rathsherr, or city councillor.   He built an observatory on the roof of his house, equipped with the finest instruments procurable, and made remarkably accurate observations.   Except for a few copies, the whole edition of Part II of his *Machina Coelestis* was destroyed by fire; but two books on comets, a star catalogue, and the *Selenographia* are extant.   This was the first complete work on the Moon (1647), with maps and drawings for every phase.   His names for lunar features were taken from terrestrial geography, but only six survive.   **294 K e**

HIEMIS, Mare.   Winter Sea.   (Frz).   295 K f

HIND.   John Russell Hind, 1823–1895.   (B)

A civil engineer, born at Nottingham, he became assistant at Greenwich Observatory, then astronomer at George Bishop's observatory in Regent's Park, London, and in 1853 superintendent of the *Nautical Almanac*.   He discovered eleven asteroids, a nova in

Ophiuchus (1848), "Hind's Nebula" in Taurus, afterwards found to be variable, and observed and computed orbits for many comets. His authoritative work on *The Comets* was very popular. **296 E f**

HIPPALUS. *c.* A.D. 120. (M)

Greek mariner, the first to sail the open sea from Arabia to India, and to discover the use of the monsoon wind to sailors. **297 H h**

HIPPARCHUS. Fl. 140 B.C. (M)

One of the greatest of all astronomers, a Greek who lived in Rhodes. He seems to have known the work of earlier Babylonian observers, and laid a sound foundation for his successors to build upon: he made the first star catalogue, determined the length of the tropic year, the size and distance of the Moon and tentatively of the Sun, and the value of precession, constructed trigonometrical tables, and improved astronomical instruments. His results are preserved in the *Almagest* of Ptolemy, who calls him a "lover of toil and truth." **298 E f**

HOLDEN. Edward Singleton Holden, 1846–1914. (Kr)

Born at St Louis, he was appointed to the U.S. Naval Observatory, then to Washburn, became adviser to the Lick trustees, proposed the site of the observatory, and became its director, building up a brilliant staff. His papers covered many branches of astronomy, especially nebulæ and red stars, as well as historical and linguistic subjects. His work with the great Lick telescope was mainly in lunar photography. **299 A g**

HOMMEL. Johann Hommel, 1518–1562. (R)

When Tycho went to Leipzig University as a young student he immediately sought out Hommel, the professor of mathematics, and studied astronomy under him, and under his disciple Schultz when Hommel died soon after. He was a native of Memmingen. To him Tycho attributed the invention of "transversals" for subdividing the graduation of instruments, which helped Tycho later to attain his unprecedented accuracy in observation. **300 D jk**

HOOK (or HOOKE). Robert Hooke, 1635–1703. (Schr)

Author of "Hooke's Law" of elasticity and the writer of *Micrographia*. He was born at Freshwater, and as a boy was clever at making mechanical toys. He became curator of experiments to the Royal Society, and made many discoveries and ingenious inventions, including the balance-spring for watches (independently of Huygens) and the conical pendulum governor for telescopic driving-clocks. **301 B b**

HORREBOW. Peder Horrebow, 1679–1764. (Schr)

Born at Loegsted, in Jutland, the son of a poor fisherman, he proved an apt pupil when Roemer took him into his house and enabled

him to earn something by helping to make astronomical instruments. Since most of Roemer's work was destroyed by fire in 1728, we are indebted to Horrebow for including in his *Opera Mathematica-Physica* a detailed description of Roemer's instruments and ideas and much of his correspondence. He also wrote *Copernicus Triumphans*, and was professor of mathematics in Copenhagen and member of the Danish Academy of Sciences. **302 G b**

HORROCKS.   Jeremiah Horrocks, 1619–1641. (B)

English astronomer whose short life was one of great promise. Born at Toxteth Park, near Liverpool, he studied at Cambridge, and became a tutor at Toxteth.   Having noted and verified the prediction in Lansberg's tables of the transit of Venus in 1639, he and his friend Crabtree were the first who ever saw this phenomenon, though his duties as lay-reader on that Sunday prevented him from observing first contact.   He made a notable advance in the lunar theory by his work on the evection.   **303 E f**

HORTENSIUS.   Martin van den Hove, 1605–1639. (R)

Dutch astronomer, born at Delft, professor of mathematics at Amsterdam.   According to Riccioli he worked for some time with Lansberg, and was "no mean observer" of the stars.   He addressed his treatise *De Mercurio sub Sole viso et Venere invisa* (1633) to Gassendi, who had seen the transit of Mercury in 1631 but missed that of Venus in the same year, because (as is now known) it occurred in the night in Europe.   Kepler had foretold both, and also (erroneously) that there would be no more transits of Venus till 1761. (*See* HORROCKS.)   **304 H e**

HUGGINS.   Sir William Huggins, 1824–1910. (B)

Eminent pioneer in astronomical spectroscopy.   At his observatory at Tulse Hill, London, he detected the main types of stellar spectra, proved the gaseous nature of certain nebulæ, was the first to examine the spectrum of a Nova (Nova Coronæ, 1866), determined radial velocities, and studied the spectra of comets, planets, and solar prominences.   He applied photography to spectral work in 1863, and more effectively in 1875 when dry plates were introduced.   His wife, Margaret Murray, was his active co-worker, and together they published the *Atlas of Representative Stellar Spectra*.   **305 F j**

N.L.F. gives Schmidt as authority, in error.

HUMBOLDT, W.   Wilhelm von Humboldt, 1767–1835. (M)

Brother of the following.   German statesman and author of valuable philological works, the most important being his posthumously published *Ueber die Kawi Sprache auf der Insel Java*, which lays down certain basic principles of modern comparative philology.   As Prussian Minister of Public Instruction he established the University of Berlin in 1809.   **306 A h**

HUMBOLDTIANUM, Mare. Alexander von Humboldt, 1769–1859. (M)

Naturalist and explorer, born in Berlin. In 1799 he went to South America, and there saw the great Leonid meteor shower of that year, and in 1802 a transit of Mercury. He explored the rivers Orinoco and Amazon, the Andes, and Mexico; studied variations of temperature with altitude, tropical storms, terrestrial magnetism, and plant distribution, and originated the use of isothermal lines. Later he travelled in Siberia. His *Kosmos*, written in his seventy-sixth year, embodies the results of all his observations. Mädler said he gave the name because this Mare, on the lunar limb, seems to link together the visible and invisible hemispheres of the Moon, as Humboldt's travels and researches linked together the east and west hemispheres of the Earth. **307 C a**

HUMORUM, Mare. Sea of Moisture. (R) **HJ g**

HUYGENS. Christian Huygens, 1629–1695. (Schr)

Born and died at The Hague, but lived for some years in Paris, and visited England to see Newton. He attained great skill in grinding and polishing telescope lenses, and in 1655 recognized that Saturn's puzzling appendage was an encircling ring, also discovered the sixth satellite, Titan. His drawing of Mars shows the Syrtis major and south polar cap. He invented the pendulum clock, the watch driven by a spring, and the achromatic eyepiece which bears his name. **309 F d**

HYGINUS. Caius Julius Hyginus, first century A.D. (R)

A native of Spain, made a freedman and appointed chief of the Palatine Library by the Emperor Augustus. He was a friend of Ovid, and had studied the writings of Eratosthenes and Aratus; and he is believed to be the author of the *Poeticon Astronomicon*, in which he treats of astronomy and describes the constellations of Aratus and the myths associated with them. **310 E e**

HYPATIA. *d.* A.D. 415. (R)

The daughter of Theon of Alexandria. She was more distinguished than her father, and the last Alexandrian mathematician of any considerable reputation. She lectured in the neoplatonic school of Plotinus in Alexandria, and wrote an astronomical canon, a commentary on the *Conics* of Apollonius, and possibly other works. She was beautiful and modest, but suffered a violent death during religious disturbances in Alexandria: her tragic story is told in Charles Kingsley's novel *Hypatia*. **311 D f**

IDELER. Christian Ludwig Ideler, 1766–1846. (Smt)

German chronologist, born at Perleberg, was tutor to the young German princes, and afterwards professor at Berlin University. He wrote on the calendars, chronology, and observations of ancient

astronomers in Egypt, Chaldea and China, Arabia and Persia, Greece and Rome.   His chief works were on the *Origin and Meaning of Star Names,* and a *Handbook on Mathematical and Technical Chronology.* His investigation of the conjunction of Jupiter, Saturn, and Mars in 7 B.C., sometimes associated with the visit of the Magi, attracted special attention.   **312 D j**

IMBRIUM, Mare.   Sea of Rains.   (R)   313 FG c

INGHIRAMI.   Giovanni Inghirami, 1779–1851.   (M)
    Member of a noble Italian family living at Volterra.   He held the chair of astronomy at the institute founded by Ximenes in Florence, and published several astronomical works—among them ephemerides of occultations of stars by the Moon; ephemerides of Venus and Jupiter for use in navigation; handy general tables of astronomy; measure of a trigonometrical base in Tuscany.   **314 HJ j**

IRIDUM, Sinus.   Rainbow Bay.   (R)   GH b

ISIDORUS.   St. Isidore of Seville, *c.* 570–636.   (R)
    Born of a distinguished family in Carthage, he became Bishop of Seville, presided twice over Church councils, and was widely known for learning and eloquence.   In his encyclopædic book on *Origins,* used for centuries as a text-book, and his treatise *De Natura Rerum,* he dealt with elementary astronomy, and had the courage and enlightenment to quote the Greek theory (usually opposed by the Church) that Earth is a sphere, and even to admit the possibility of an unknown continent south of the equator.   **316 C f**

JACOBI.   Karl Gustav Jacob Jacobi, 1804–1851.   (M)
    German Jewish mathematician, born at Potsdam.   Doctor of philosophy at Berlin University, then professor of mathematics at Königsberg, then studied privately at Berlin from 1842 till his death there.   His mathematical work included the study of elliptic functions and determinants: a certain determinant has been called a "Jacobian."   He also wrote on the theory of numbers, differential equations, planetary theory, and other dynamical problems.   **317 E k**

JANSEN.   Zacharias Janszoon, *d.* 1619.   (M)
    Optician of Middelburg; discovered by accident the first compound microscope, a double convex lens serving as object-glass and a double concave lens as eyepiece: a microscope reputed of his construction is preserved at Middelburg.   In this work he appears to have been aided by his father, Hans.   One of the first telescope-makers, his son claimed that he made a telescope in 1604 on the model of an Italian instrument of 1590!   Extant documents however favour the priority of Lippershey, followed by Metius (brother of Adrian Metius): Jansen however certainly had the telescope soon after.   **318 C d**

JANSSEN. Pierre Jules César Janssen, 1824–1907. (B)

Born in Paris, famous for his discovery, independently with Lockyer, of the method for observing prominences without an eclipse (1868). He measured terrestrial magnetism in Peru and the Azores, observed two transits of Venus in Japan and Algeria, and founded the Mt Blanc Observatory for studying the solar spectrum. From 1875, as Director of Meudon Observatory, he took a great series of photographs and published them in his *Solar Atlas*. **319 C j**

JULIUS CAESAR. *c.* 102–44 B.C. (R)

The great Roman deserves the gratitude of astronomers for his reform of the calendar. The Greek luni-solar cycles were complicated, the Egyptian solar year of 365 days was too short. The Julian Calendar had a leap year with 12 months of 31 and 30 days alternately (366 days), followed by three years when February had only 29. This simple arrangement of months is said to have been spoiled by Augustus. Other connections with astronomy are: Caesar's first acquaintance with tides when crossing to Britain, and the bright comet seen after his death. **320 D e**

JURA, Mts. (Deb) **GH b**

KAISER. Frederick Kaiser, 1808–1872. (Smt)

Born at Amsterdam, and educated by an uncle who was an enthusiastic amateur astronomer, he became Director of Leyden Observatory, and by his efforts new buildings were erected in 1860. He was an excellent observer, especially of double stars and of Mars, whose surface he mapped and rotation period he determined by comparing old and new drawings, including that made by Huygens in 1672. The region now known as Syrtis Major was for some years called in England the Kaiser Sea. **322 E hj**

KANE. Elisha Kent Kane, 1820–1857. (Smt)

American explorer born in Philadelphia. In spite of chronic heart weakness he made many expeditions, including a descent into the crater of Tael in the Philippines, and took part in expeditions to search for Sir John Franklin, in the first as surgeon, the second as commander: these were unsuccessful, but added materially to our knowledge of the North Polar regions. **323 DE a**

KANT. Immanuel Kant, 1724–1804. (M)

German philosopher of world-wide fame, author of the *Critique of Pure Reason*. He lived and died in Königsberg, where he was university lecturer. In his work on the *Nature and Theory of the Universe* (1755) he propounded a Nebular Theory for the origin of the solar system similar to that of Laplace (1796), and also suggested that the Galaxy is a lens-shaped structure whose component stars circle round a central point as planets circle round the Sun, and that nebulæ are distant galaxies of stars resembling our own. **324 D f**

5

KÄSTNER.   Abraham Gotthelf Kästner, 1719–1800.   (M)

Born at Leipzig, and was professor of mathematics and physics in Göttingen University for over half a century.   His knowledge was extensive: he wrote on almost every branch of mathematics, including a *History of Mathematics* in four volumes, on many kinds of scientific instruments including telescopes, on geodesy and maps, on the Sun and sunspots, on the Moon and eclipses.   Among his pupils were Olbers and Schröter.   **325 A f**

KELVIN.   William Thomson, Lord Kelvin, 1824–1907.   (Kr)

As professor of natural philosophy at Glasgow, for fifty-three years, he made important contributions to thermodynamics, atomic and molecular theory, electricity, and electromagnetic theory, with over sixty inventions, among which his submarine-cable work is notable.   Made a peer in 1892, he took his title from a river near Glasgow University, but the name is applied to a cape on the Moon. In astronomy he studied tidal distortion of the Earth's figure and the origin of the Sun's energy.   **326 H h**

KEPLER.   Johann Kepler, 1571–1630.   (R)

Born in Württemberg, and at Tübingen University an enthusiastic student of the Copernican system, he became assistant to Tycho Brahe at Prague, and succeeded him as mathematician to the Emperor Rudolf, on a small irregular salary.   Using Tycho's observations, he was able to formulate his Three Laws, in which the age-old theory of circular celestial motions round a central Earth was at last superseded by elliptical planetary orbits round a central Sun: Copernicus was vindicated and the way prepared for Newton. **327 HJ e**

KIES.   Johann Kies, 1713–1781.   (Schr)

German mathematician, born and died in Tübingen.   He was mathematician to the Polish Prince Czartoryski in Warsaw, and later astronomer in Berlin.   He wrote much on astronomical subjects. **328 G h**

KINAU.   C. A. Kinau, fl. 1850.   (N)

Botanist and selenographer.   He had an official post on the estate of the Prince of Schwarzenberg in southern Bohemia, and published in 1842 two works on Poisonous Plants and Fungi.   Some lunar observations of his were published in Jahn's *Wochentliche Unterhaltungen*, 1848.   He made a specialty of "rills": Neison mentions his discovery of six, made in 1847–1848; and the *Selenographical Journal* for January 22, 1879, refers to "a large number of drawings of lunar rills" which Kinau had accumulated, representing "nearly 30 years' work with a $5\frac{1}{2}$-inch equatorial refractor of fine quality," and expresses a hope that these may be published.   **329 E k**

KIRCH. Gottfried Kirch, 1639–1710. (Schr)

The splendid comet of 1680 was discovered by him telescopically, also the third variable star to be known, Chi Cygni. Born at Guben, he studied at Jena, and for some time assisted Hevelius at Danzig. When the old Royal Observatory was established in Berlin in 1705 by Frederick, first King of Prussia, he was appointed director. Margarethe Kirch, his wife, helped him in observing and computing tables and ephemerides, wrote some astronomical papers, and discovered a comet in 1702. Their son and daughter, Christfried and Christine, also assisted, and carried on the work after their parents' death. **330 F b**

KIRCHER. Athanasius Kircher, 1601–1680. (R)

Professor of oriental languages and mathematics at Würzburg, later in Avignon, then in Rome. He was born in Fulda (Germany), gained a European reputation for erudition and had also a lively imagination. He studied Egyptian hieroglyphics, and translated many Arabic star names. In his book on the magnet he ascribes to its agency a healing power and animal faculties such as the flight of birds. Another work describes an imaginary journey through the Universe, when he finds volcanoes on Mars, and mountains, valleys, and seas on the Moon. **331 G k**

KIRCHHOFF. Gustav Robert Kirchhoff, 1824–1887. (Smt)

Professor of physics at Heidelberg, where with his colleague Bunsen he discovered in 1859 the fundamental principles of spectrum analysis, demonstrating the significance of emission, absorption, and continuous spectra. Kirchhoff then applied their results to the Sun, and proved by direct experiment the existence of sodium and other elements in the solar atmosphere. His great map of the solar spectrum was published by the Berlin Academy in 1860. **332 C c**

KLAPROTH. Martin Heinrich Klaproth, 1743–1817. (M)

German chemist and mineralogist, born at Wernigerode. During a large portion of his life he was an active manufacturing apothecary in the commercial field: he became professor of chemistry at Berlin University in 1810. He discovered but did not isolate uranium, titanium, zirconium, and cerium, naming the first after Herschel's planet: Berzelius named the last after Piazzi's planet Ceres. He advanced the theory of the conservation of mass by his careful quantitative work, enjoyed much success as a teacher, and was regarded as the foremost chemist in Germany of his day. **333 F k**

KLEIN. Hermann Joseph Klein, 1844–1914. (Kr)

German selenographer, born in Cologne; a pupil of Heis. His first research was on the figure of the Earth. He became Director of Cologne Observatory, and an influential popular writer; edited *Sirius* and *Jahrbuch für Astronomie und Geophysik*, and published a well-

known *Star Atlas*, a *Handbuch der Astronomie* with a detailed description of the Moon, and a popular *Meteorology*. He discovered the colour change of α Ursae Majoris, prepared an excellent map of the Milky Way, and originated the controversy about Hyginus N. An island in terrestrial North Polar regions was named after him.   **334 Eg**

KÖNIG. Rudolf König, 1865–1927. (Mül)

A successful business man of Vienna, he was also musician and mathematician, a lover of art and nature, books and travel, but above all of astronomy, and built his own observatory. He devoted nearly four years to editing Krieger's unfinished lunar sketches and maps, writing an admirable detailed description; then made 47,000 measurements of lunar features, and reduced about 10,000, but died before he had published or used them in constructing a map.   **335 G h**

KRAFFT. Wolfgang Ludwig Krafft, 1743–1814. (Schr)

Born, lived, and died in St Petersburg, where his father had gone from Germany to become professor of mathematics in the university there. The son was professor of astronomy and also a physicist. He observed the comet of 1769, compiled tables for finding longitudes at sea from lunar distances, and carried out considerable experimental work in terrestrial gravity and ballistics.   **336 K d**

KRIEGER. Johann Nepomuk Krieger, 1865–1902. (Kön)

The son of a Bavarian farmer, he sold his farm and went to Munich to study astronomy. Here he began his work on the Moon, but moved to Trieste for better observing conditions, and there built the Pia Observatory, named after his wife. In 1898 he published the first volume of his *Lunar Atlas*, containing drawings of fine details inserted in enlarged photographs from Paris Observatory; but he afterwards fell ill, and died at San Remo. König, ten years later, published the second volume.   **337 J c**

KRUSENSTERN. Adam Johann, Baron von Krusenstern, 1770–1846. (Smt)

Russian naval officer, born in Esthonia. He commanded an exploring expedition to the North Pacific, and finally sailed round the world, 1803–1806.   **338 E h**

KUNOWSKY. Georg Karl Friedrich Kunowsky, 1786–1846. (N)

Son of a clergyman in Beuthen (Silesia), where he was born. He studied law, and was Justizrat in Berlin, but was also interested in natural science, including astronomy. He discovered Zeta Orionis to be double; but devoted his attention chiefly to Moon and planets, especially Saturn. His discoveries of lunar "rills," and his drawings of Ptolemaeus, Ariadaeus, Alhazen, and other formations, attracted the attention of Neison and other selenographers to his careful, conscientious work. He lost his life in a railway accident near Kohlfurt.   **339 He**

LACAILLE. Nicholas Louis de la Caille, 1713–1762. (Schr)

Born in the village of Rumigny, in the Ardennes, he studied for the Church, but was enamoured of astronomy, and worked under Jacques Cassini in Paris Observatory and on geodetic surveys; then became professor at the Collège Mazarin, with an observatory in the attics. To supplement his studies of northern stars he went to the Cape, where he catalogued and mapped the southern skies, naming several new constellations, measured an arc of meridian (the first so far south), and determined the Moon's parallax jointly with Lalande in Europe. **340 EF gh**

LACROIX. Sylvestre François de Lacroix, 1765–1843. (N)

French mathematician and teacher, who held several appointments in the military and artillery colleges of France. He wrote many text-books in all the branches of mathematics, including his celebrated *Cours de Mathématiques* in ten volumes. He was born and died in Paris. **341 J j**

LADE. Heinrich Eduard von Lade, 1817–1904. (Kr)

A Hamburg banker, born at Geisenheim on the Rhine, where in 1860 he built an observatory on his private estate of Monrepos, planted orchards and flower gardens, and founded a school for fruit and wine culture. His name was given to commemorate his success in awakening popular interest in selenography, especially by an ingenious lunar globe in relief executed on his design, and his *Mondbeschreibung*. He was ennobled in 1901, and died at Geisenheim, which is still famous for its wine. **342 E f**

LAGALLA. Giulio Cesare Lagalla, 1571–1624. (Fauth)

Born at Padulla, near Naples, he entered the Jesuit Order, studied medicine and philosophy and became professor of philosophy at Rome, where he died. He was one of the first to use the newly discovered telescope, and published in 1612 his *Disputatio physica de novis Phaenomenis in Orbe Lunae*, with a drawing of the Moon, apparently second in date only to Galileo's. **343 G j**

LAGRANGE. Joseph Louis Lagrange, 1736–1813. (M)

Born in Turin, this young mathematical prodigy was early promoted to be professor there, teaching pupils older than himself. In 1766 Frederick II invited him to Berlin, saying "the greatest king in Europe wished to have the greatest mathematician at his Court"; and in 1787 Louis XVI invited him to Paris, where he remained till his death. His masterpiece was the *Mécanique Analytique*, but he wrote also numerous papers on astronomy, including a prize essay on the Moon's libration, as well as on general dynamics and pure mathematics. **344 J h**

LAHIRE. Philippe Lahire, 1640–1718. (M)

Son of a French artist, he began his career as landscape and portrait painter, then studied mathematics and wrote a treatise on *Conic Sections*, also worked at engineering and hydraulics. He was simultaneously professor of mathematics at the Collège de France and of architecture at the Academy, and at Paris Observatory he made many astronomical observations, measured the ellipticity of Jupiter's disc, compiled tables, and made a drawing of the Moon. **345 G c**

LALANDE. Joseph Jérôme le François de Lalande, 1732–1807. (Lo)

Pupil and successor of Delisle at the Collège de France, and later Director of Paris Observatory. When only nineteen he was sent to Berlin to make lunar observations for comparison with those of Lacaille at the Cape, on nearly the same meridian, to determine thence the lunar parallax. He was an admirable popularizer of astronomy, also a tireless calculator and observer. He wrote a comprehensive *Traité de l'Astronomie*, a useful *Bibliothèque Astronomique*, and the *Histoire Céleste Française*. **346 F f**

LAMBERT. Johann Heinrich Lambert, 1728–1777. (Schr)

A tailor's son in Mülhausen, Alsace; but while learning his father's business he contrived to obtain education enough to become tutor in a private family, and accompanied his pupils to Göttingen University. He studied and wrote on refraction and absorption of light, albedo of planets, theory of cometary orbits, also on pure mathematics; and in his *Kosmologische Briefe* he discussed the structure of the Universe. In 1764 he went to Berlin and was made member of the Academy. **347 G c**

LAMÈCH. Felix Chemla Lamèch, 1894–   . (Mül)

Born in Ariana (Tunis), and served in the French Army throughout the Great War, then resumed his studies in Paris, and in 1923 went to Greece for astronomical work, especially on the Moon. He built Corfu Observatory and was its first director. Later, he held in Toulouse an official post in the Cie Air-France. In his *Carte topographique de la Lune* (1934) co-ordinates of latitude and longitude are marked with their south pole in Tycho, thus illustrating the theory of Delmotte (*q.v.*). He is also issuing a series of monographs on the larger lunar formations. **348 E b**

LAMONT. John Lamont, 1805–1879. (Kr)

A star-lover from childhood. At eleven years of age he left his home in Braemar, Scotland, travelled in a farm-cart to Aberdeen, and thence to Ratisbon (Bavaria), where with other schoolboys he had been offered free education; passed on to Munich Gymnasium, and from 1835 was Director of Munich Observatory. He published star catalogues, measured nebulæ and star clusters, studied the satellites of Jupiter and Saturn, and discovered a period in variations of magnetic

force which was later shown to synchronize with the sunspot period. (*See* SABINE.) **349 D e**

LANDSBERG. *See* LANSBERG.

LANGRENUS. Michel Florent van Langren, *c.* 1600–1675. (R)

Belgian engineer and mathematician, sent by Isabella, Regent of the Netherlands, to Spain, where Philip IV appointed him Court Astronomer. He invented a method of determining longitudes by lunar observations, and engraved on copper a Map of the Full Moon, the first that had names of the formations: some of these were retained by Riccioli. It was published at Philip's expense in 1645. Van Langren proposed to add thirty maps showing the different phases, with text, the whole to be called *Selenographia Langreniana,* but he was unable to complete this, apparently owing to lack of funds. Returning to Belgium, he designed canals and fortifications, and died in Brussels. **350 A f**

LANSBERG. Philippe van Lansberge, 1561–1632. (R)

Born at Ghent, son of the squire of Meulebeke. He studied in France and England, was Protestant minister at Antwerp and in Zeeland, then retired to Middelburg and devoted himself to medicine and astronomy. He published a *Uranometry,* works on the astrolabe and gnomon, and trigonometrical tables which were useful to Kepler. A staunch Copernican, his *Considerations* on Earth's movements, translated into Latin by Hortensius, led to much controversy. He is best known by his tables of Sun, Moon, and planets, long favoured for their simplicity, which enabled Horrocks to view the transit of Venus in 1639. (*See* HORROCKS.) **351 H ef**

Neison and *N.L.F.* spell the name with a d—Landsberg—in error. Riccioli spelt it correctly (in its Latinized form), Lansbergius.

LAPEYROUSE. Jean François de Galoup, comte de la Pérouse, 1741–1788. (M)

French navigator, leader of an expedition which was equipped to sail round the world, but was lost in the Pacific. His journals were published as *Voyage autour du Monde,* and a strait in Japan bears his name. **352 A fg**

LAPLACE. Pierre Simon Laplace, 1749–1827. (M)

Famous French mathematician, who developed Newton's work, his *Mécanique Céleste* placing on a very high level the whole subject of dynamical astronomy. He discovered a secular inequality in the Moon's motion, due to the varying eccentricity of the Earth's orbit; and in his *Système du Monde* he suggested the Nebular Hypothesis to explain the evolution of our solar system. He was born in Beaumont-en-Auge of peasant parents, and was honoured by all the scientific societies of Europe. **353 G b**

LASSELL.   William Lassell, 1799–1880.   (B)

A Lancashire brewer and keen amateur astronomer, who built an observatory near Liverpool and made a telescope with two-foot speculum mirror of excellent definition and ingenious equatorial mounting.   With this he discovered Neptune's satellite within seventeen days of the discovery of the planet, also a satellite of Saturn (simultaneously with Bond), and two of Uranus.   To improve conditions of seeing he went to Malta, and discovered 600 nebulæ in about two years.   **354 F g**

LAVINIUM, Prom.   (B)

This and Olivium are close together and were named at the same time, but without explanation.   **355 B d**

LAVOISIER.   Antoine Laurent Lavoisier, 1743–1794.   (M)

One of the great founders of modern chemistry.   He overthrew the phlogiston theory and established the true theory of combustion; systematized the classification and nomenclature of chemistry; and applied it to agriculture.   Near his château of Fréchines he founded a free school; he helped young scientists; and his other philanthropic activities were many.   He was executed during the Terror.   **356 J b**

LEE.   Dr John Lee, 1783–1866.   (B)

Antiquarian and collector, he had in his home, Hartwell House, "a wonderful and crowded museum," and also an observatory, where he worked with his friend Admiral Smyth, and gave names to several lunar craters.   Their observations were published in the *Speculum Hartwellianum*.   He was a generous patron of astronomy, an original member of the R.A.S., and president in 1861–1863.   **357 H h**

LEGENDRE.   Adrien Marie Legendre, 1752–1833.   (M)

French mathematician, born in Toulouse.   He served on the commission to connect Paris with Greenwich by triangulation; but his reputation rests on his work on elliptic functions and the theory of numbers, and his *Elements of Geometry*, which was generally adopted on the continent as substitute for Euclid.   He was professor at the military school in Paris, and later at the Normal School. **358 A h**

LEGENTIL.   Guillaume Hyazinthe Legentil, 1725–1792.   (Schr)

French astronomer, pupil of Delisle and assistant to Jacques Cassini.   Having failed to reach Pondicherry for the transit of Venus in 1761, owing to the Anglo-French war, he spent eight years exploring from Madagascar to Manila till the transit of 1769, but clouds developed at Pondicherry as it began.   In his *Voyage dans les Mers de l'Inde* he records all he learned of geography and geophysics and ancient Hindu astronomy.   **359 G k**

LEHMANN. Jacob Heinrich Wilhelm Lehmann, 1800–1863. (M)

A student of theology at Halle, Berlin, and Göttingen, he entered the Church in 1828, but was always interested also in astronomy, and published a forecast of the annular eclipse of 1820, and of the return of Halley's comet in 1835. His work on eclipses, especially that of 1842, was burned in a great Hamburg fire, but a second edition quickly followed. He then retired from preaching and devoted himself to astronomy, and it was in the midst of work on planetary orbits that he suddenly died. **360 J j**

LEIBNIZ. Gottfried Wilhelm Leibniz, 1646–1716. (Schr)

Philosopher and mathematician. He was born at Leipzig, visited Paris and London, and became librarian, historian, and political secretary to the Elector of Hanover and his son (afterwards George I of England). He invented the calculus independently of Newton, and his differential notation (published 1684) is always used, in preference to Newton's fluxional. He also wrote on mechanics and movements of the planets. **E k**

LEMONNIER. Pierre Charles Lemonnier, 1715–1799. (Schr)

French astronomer and professor of physics in Paris. He went with Maupertuis to Lapland in 1736 to measure an arc of meridian nearly 1° long, close to the Arctic Circle. When editing the *Atlas Céleste*, containing Flamsteed's maps and Lacaille's southern planisphere, published under the auspices of the Académie des Sciences in 1776, he introduced a Reindeer near the North Pole to commemorate the Lapland expedition. (*See* CONDAMINE.) **362 C c**

LEPAUTE. Madame Lepaute, *née* Nicole Reine de la Brière, 1723–1788. (Kr)

She was early attracted to astronomy, studying with Clairaut and Lalande. She carried out under Clairaut's direction much of the computation for the 1758 return of Halley's comet; helped for many years in preparing the *Connaissance des Temps*; and assisted Lalande with his tables. She collaborated with her husband, a famous French clockmaker, in his *Traité d'Horlogerie*, and cared for him devotedly until her death, only a few months before his own. **363 H h**

LETRONNE. Jean Antoine Letronne, 1787–1848. (M)

French archæologist. Son of a poor engraver, he became a leading authority on ancient Egyptian civilization. He was commissioned by the Government to complete a translation of Strabo, the Greek geographer, and in 1840 became Keeper of the National Archives. He was born and died in Paris. **364 J fg**

LEVERRIER. Urbain Jean Leverrier, 1811–1877. (Smt)

Brilliant French mathematician and astronomer, who discovered Neptune independently of Adams, his calculations enabling Galle in

Berlin to find the planet on September 23, 1846. (*See* CHALLIS.) His chief work was in celestial mechanics, carrying on and developing that of Laplace, especially in solar and planetary theory. As Director of Paris Observatory, he reorganized instruments and staff, and added meteorological and computing departments. **365 G b**

LEXELL. Anders Johann Lexell, 1740–1784. (M)

Born at Abö, in Finland, then part of Sweden. As professor of mathematics at St Petersburg he wrote with Krafft a treatise on the lunar theory, and investigated the orbits of comets, especially that of 1770, which is therefore called by his name, and is the most famous of "lost comets." He was in England when Herschel discovered Uranus, and was the first to prove that it was not a comet but a planet with a nearly circular orbit beyond that of Saturn. **366 F h**

LICETUS. Fortunio Liceti, 1577–1657. (R)

An Italian physician and philosopher, born at Rapallo. He was successively professor of physics at Pisa and of philosophy at Padua and Bologna, becoming finally professor of medicine at Padua. He wrote on comets and stars, including the Nova (or comet ?) of A.D. 389, also on the faint illumination of the dark part of the Moon when crescent or eclipsed. **367 E j**

LICHTENBERG. Georg Christoph Lichtenberg, 1742–1799. (M)

German physicist who experimented in static electricity and is remembered for his "Lichtenberg figures." He was also well known as a satirist, and his biting wit involved him in many controversies with his contemporaries. He was born near Darmstadt and died at Göttingen, where he was professor of physics and editor of a magazine of literature and science. **368 J c**

LICK. James Lick, 1796–1876. (Kr)

The founder of Lick Observatory. He was a manufacturer of musical instruments, born in Pennsylvania. He made a fortune in California through various enterprises, and in 1874 gave to the astronomical department of the University of California funds to provide "a telescope superior to and more powerful than any telescope yet made, and a suitable observatory." He died in San Francisco, and in accordance with his will was buried under the great refractor. **369 B d**

LIEBIG. Justus, Baron von Liebig, 1803–1873. (Smt)

Founder of the great school of chemical teaching at Giessen (Germany). His researches enriched every branch of scientific and industrial chemistry, and his later life was devoted to the chemistry of nutrition and processes of life. He invented a process for depositing thin films of silver on glass, which was applied to telescope mirrors. He was born in Darmstadt and died in Munich. **370 J h**

LILIUS. Luigi Giglio, *d.* 1576. (R)

Italian physician and philosopher born at Cirò in Calabria (date unknown). He devised a method of reforming the Julian Calendar, which, though he did not live to see it, was unanimously adopted as the best by all the learned men summoned to Rome by Pope Gregory to discuss the problem in 1582. He was called by Blancanus, and by Clavius, who formed and explained the new calendar, "the Sosigenes of our age." (*See* SOSIGENES.) **371 E k**

LINDENAU. Bernhard von Lindenau, 1780–1854. (M)

German astronomer, soldier, and politician, born at Altenburg. He was Director of the Observatory there, served in the war of 1813, and later held numerous official appointments. His astronomical career was devoted to fundamental astronomy, and he published tables of Venus, Mars, and Mercury, based on the work of Laplace. He died at Altenburg. **372 D h**

LINNÉ. Carl von Linné (Linnæus), 1707–1778. (M)

Swedish botanist, born at Rashult. His *Genera Plantarum* brought order out of confusion, and by its methodical classification and nomenclature laid the foundation of modern systematic botany. He travelled in Lapland, Holland, France, and England, to enlarge his knowledge of plants, and after returning to Sweden practised as physician; became professor of medicine and botany at Uppsala, and died there. **373 E c**

LIPPERSHEY. Hans Lippershey (Jan Lapprey), *d.* 1619. (Kr)

Inventor of the telescope. He was a spectacle-maker of Middelburg (Holland), who happened to look through a convex and a concave lens at a weathercock and saw that it was magnified, fixed the glasses in a tube, and on October 2, 1608, applied for a patent. News of his discovery spread quickly and telescopes were made and used by Galileo and others. **374 F h**

LITTROW. Johann Josef von Littrow, 1781–1840. (M)

Born at Bischofteinitz, in Bohemia, he became professor of astronomy at Cracow, founded the observatory at Kasan, and was for some time at Budapest; then was appointed Director of Vienna Observatory and continued in charge there till his death. He was author of numerous mathematical and optical investigations, and of several popular works on astronomy, including *Die Wunder des Himmels*. His eldest son, Karl von Littrow, succeeded him at Vienna, and is known as inventor of the Littrow form of spectroscope. **375 C d**

LOCKYER. Sir Norman Lockyer, 1836–1920. (B)

Pioneer in astrophysics. In 1866 he initiated spectroscopic observations of sunspots, and in 1868 discovered, simultaneously with

Janssen, that prominences can be seen spectroscopically without an eclipse. He discovered helium in the Sun when it was unknown on Earth; used the Doppler effect in measuring solar rotation; and interpreted the "enhanced" lines in stellar spectra. He was Director of the Solar Physics Observatory in South Kensington, led eclipse expeditions, founded and edited *Nature*, and wrote several books on astronomy. **376 C j**

LOEWY. Moritz Loewy, 1833–1907. (Kr)

Born in Vienna, of Jewish extraction, later naturalized in France, his work is entirely associated with Paris Observatory, of which he ultimately became director. He edited *Connaissance des Temps* and *Annuaire du Bureau des Longitudes* for thirty years, founded the observatory of the latter body, and took a leading part in the *Carte du Ciel*. He invented the equatorial coudé, studied flexures, and contributed largely to fundamental astronomy, especially aberration, devising the double-mirror instrument. Later work was mainly on the Eros campaign and, with Puiseux, the great lunar atlas. **377 Hg**

LOHRMANN. Wilhelm Gotthelf Lohrmann, 1796–1840. (M)

Land surveyor and selenographer of Dresden. His *Topography of the Visible Face of the Moon* was intended to be a detailed lunar map in twenty-five sections: the scale was $37\frac{1}{2}$ in. to the Moon's diameter, and the positions were determined by scientifically accurate measures. Failing eyesight prevented his completing more than four sections, but he published an excellent fifteen-inch map of the whole disc in 1838, and the *Topography* was completed from his materials by Schmidt in 1878. **378 K f**

LOHSE. Oswald Lohse, 1845–1915. (Kr)

Born at Leipzig, he first studied chemistry, then turning to astrophysics worked with Vogel at Bothkamp and Potsdam. His many papers included work on the arc spectra of cerium and other metals, spectra of novæ, double-star orbits, and planetary photography; he was a leading Martian cartographer, and investigated the problem of coronal photography in daylight. **379 A g**

LONGOMONTANUS. Christian Sörensen Longomontanus, 1562–1647. (R)

A peasant lad who educated himself, and took a Latin name from his birthplace, the village of Longberg in Denmark. He became Tycho's assistant at Hveen and Prague. After Tycho's death he returned to Denmark, was appointed professor of mathematics in Copenhagen, and persuaded King Christian to build the Round Tower Observatory there in 1637. His *Astronomica Danica* is mainly founded on Tycho's work and supports Tycho's system, though he also describes those of Ptolemy and Copernicus. **380 G j**

LOUVILLE. Jacques d'Allonville, Chevalier de Louville, 1671–1732. (Schr)

Mathematician and astronomer, who saw considerable service both in the French Army and Navy. He wrote a memoir on planetary theory, based on Newton's principles, which was published by the Académie des Sciences, 1720, and devised a method for the precise computation of the circumstances of a solar eclipse. He was born at Allonville, and died at Carré, near Orleans. **381 H b**

LUBBOCK. Sir John William Lubbock, 1803–1865. (N)

Mathematician and astronomer, born in Westminster, died at Farnborough. He published a series of important memoirs on planetary and lunar theory, and also on tides; and received a testimonial from the R.A.S. Neison notes (in *The Moon*) that his results in lunar work entirely confirmed those arrived at by Plana. **382 B f**

LUBINIEZKY. Stanislaus Lubiniezky, 1623–1675. (Schr)

A Polish nobleman and astronomer, who was born at Racow, near Cracow. His surviving work all concerns comets. The earliest was about the comets of 1664–1665, and in 1667 he published a work in two volumes on the movements of 415 comets. He died at Hamburg. **383 G g**

LUTHER. Robert Luther, 1822–1900. (Smt)

Born at Schweidnitz, studied astronomy under Encke in Berlin, and was Director of the Bilk-Düsseldorf Observatory from 1851 till his death, when his son Wilhelm succeeded him. Dr Robert Luther was a famous discoverer of minor planets before the days of photography, discovering twenty-four between 1852 and 1890, and he also did much excellent work in computing orbits and publishing ephemerides of these bodies. **384 D c**

LYELL. Sir Charles Lyell, 1797–1875. (Smt)

Born in Forfarshire, son of a noted botanist, he was called to the Bar, but taking up geology as a hobby soon made it his life-work; made a series of Continental tours and two in U.S.A. in this pursuit; and wrote many works on the subject. His *Principles of Geology* finally discredited the catastrophic school, and is one of the fundamental works of modern geology. **385 B d**

MacCLURE. Robert le Mesurier McClure, 1807–1873. (B)

Educated at Eton and Sandhurst, entered the British Navy, and made an Arctic voyage, 1836–1837, was promoted lieutenant, and served in Canada and the West Indies. He commanded an expedition in search of Franklin, and discovered the North-West Passage, but had to abandon his ship in 1854; was court-martialled but honourably acquitted, knighted, and made captain. He then served in China

and the Straits of Malacca, and was made vice-admiral. (*See* CROZIER.) **386 B g**

> The correct spelling of this name is McClure.

MACLAURIN.   Colin Maclaurin, 1698–1746. (M)

Professor of mathematics at Aberdeen at the age of nineteen, he later succeeded Gregory at Edinburgh, and developed Newton's mathematical work. Lagrange and Clairaut admired his writings; his *Treatise on Fluxions* solved many problems in astronomy; and his essay on *Tides* won a prize from the Académie des Sciences, shared by Euler and Bernouilli. In 1745 he helped to organize the defence of Edinburgh against the Young Pretender, and died at York from the privations endured. **387 A f**

MACLEAR.   Sir Thomas Maclear, 1794–1879. (Lee)

Irish astronomer, born in Tyrone; he practised as physician and had a private observatory at Biggleswade (Bedfordshire). In 1833 he went to the Cape as His Majesty's Astronomer, worked at stellar parallaxes, and repeated Lacaille's measure of an arc of meridian, extending it into unexplored country, wild and waterless. **388 D e**

MACROBIUS.   Ambrosius Aurelius Theodosius Macrobius, fourth century A.D. (R)

A grammarian who lived under the Emperor Theodosius. He says that Latin was to him a foreign tongue, and his style suggests that he was Greek. In his commentary on Cicero's *Dream of Scipio* (a visionary flight to the stars) he explains that the Moon receives her light from the Sun, and discusses the nature of the Milky Way, the movements of the planets, and the music of the spheres. **389 B d**

MÄDLER.   Johann Heinrich Mädler, 1794–1874. (Smt)

Born in Berlin, where he earned a living by teaching. In 1824 he met Beer: they worked together at astronomy, and published a map of Mars and in 1837 the first adequate description and map of the Moon, *Der Mond*, with its three-foot "Mappa Selenographica." It was based on their own and Lohrmann's measures, and included among its fundamental points Bouvard and Nicollet's determination of the crater Manilius. In 1840 Mädler was appointed Director of Dorpat Observatory, where he worked almost to the end of his life. **390 C fg**

MAGELHAENS.   Fernão de Magalhães (Magellan), 1480–1521. (M)

The great Portuguese navigator, the first man to round Cape Horn and the first European to enter the Pacific, which still retains the flattering name he gave it. His fleet completed the first circuit of the globe, but he was killed in a skirmish with natives at Matan. The Magellan Straits commemorate his name. **391 B g**

MAGINUS. Giovanni Antonio Magini, 1555–1617. (R)

"Insignis astronomus et cosmographicus," says Riccioli. Born in Padua, he became professor of astronomy and mathematics in Bologna. He published useful ephemerides and tables, but chiefly followed Ptolemy in astronomical theory, and wrote a work on astrology. His book on square root extraction was dedicated to Tycho, with whom he corresponded, but the copy sent failed to reach Uraniberg, and Tycho refrained from sending his star catalogue to Bologna because transit was so difficult and uncertain. He had a quadrant made like Tycho's from the description given to him by Sasceride. (*See* SASSERIDES.) **392 F j**

MAIN. Robert Main, 1808–1878. (B)

Born near Rochester, in Kent. He was for twenty-five years chief assistant to Airy at Greenwich Observatory, then Radcliffe Observer (Oxford), and edited the first Radcliffe star catalogue. He received the R.A.S. Gold Medal, and was president 1859–1861. His address in awarding the medal to Hansen was important: he summarized the early work on lunar observations and theory, and emphasized the great value of Hansen's Lunar Tables. **393 E a**

MAIRAN. Jean Jacques d'Ortous de Mairan, 1678–1771. (Schr)

Born at Béziers, in southern France. He succeeded Fontenelle as secretary of the Académie des Sciences. He wrote on geophysics, including the *Traité de l'Aurore Boréale*, suggested by the famous aurora of October 1726 which was seen as far south as Cadiz. He also studied the Zodiacal Light; and he asked the Jesuit missionaries in Peking to determine the length of the seconds pendulum there, for comparison with Madrid in the same latitude. **394 H b**

MALAPERT. Charles Malapert, 1581–1630. (R)

Belgian Jesuit, philosopher and astronomer, born at Mons, became professor of mathematics at Douai, and died in Vittoria, in Spain. He was one of the first to observe sunspots, and wrote a short treatise upon them: he believed them to be planets circling round the Sun, and called them Sidera Austriaca in honour of the Austrian sovereign. He made a small map of the Moon. **395 EF k**

MALLET. Robert Mallet, 1810–1881. (Smt)

Son of an ironfounder in Dublin. He designed swivel bridges over the Shannon, and built the Fastnet Rock Lighthouse. He presented to the Royal Irish Academy a noteworthy paper on *Dynamics of Earthquakes*, and many on the same subject to the Royal Society, of which he was a Fellow. He received a medal from the Geological Society of London for this research, and one from the Institute of Civil Engineers for his paper on *Elasticity in Wrought Iron*. **396 C j**

MANILIUS.　First century B.C.　(R)

A Roman poet, known solely as author of the *Astronomicon*, a learned poem dedicated to Augustus Caesar, on the astronomy and astrology of his time.　It includes a description of the ancient constellations as found in Aratus; and he supposes that the unseen South Pole is surrounded by constellations similar to those of the North—Bears, Dragon, and the rest.　It was translated into English verse in 1675 by Sherburne.　**397 E d**

MANNERS.　Russell Henry Manners, 1800–1870.　(B)

Born in London, and entered the Royal Naval College at the age of thirteen.　He served in the East Indies and elsewhere, retired from active service in 1849, and was made admiral in 1865.　He was much interested in science, and acted as secretary to the R.A.S. for ten years, then foreign secretary till 1868, when he was elected president, and died while in office.　**398 D e**

MANZINUS.　Carlo Antonio Manzini, 1599–1677.　(R)

Doctor of philosophy at Bologna, where he was born, and a great friend of Riccioli.　He published astronomical tables, made many observations, and wrote several scientific works, including one on solar and lunar haloes.　In the art of figuring lenses he was an expert, both theoretical and practical, as is evidenced by his writings, especially *L'Occhiale all' Occhio*, and also by the admiration in which he was held by Eustachio Divini, the well-known telescope-maker, and others of his contemporaries.　**399 E k**

MARALDI.　Giovanni Domenico Maraldi, 1709–1788.　(Schr)

The sister of Domenico Cassini, Director of Paris Observatory, married a Maraldi: their son, Jacques Philippe (1665–1729), and later his nephew, Giovanni Domenico, were assistants to the Cassinis, and both did useful work at the observatory.　The young Maraldi, a silent diligent man, edited the *Connaissance des Temps*, and when Lacaille died completed and published his unfinished atlas of southern stars.　He continued to work at Jupiter's satellites after retiring to his birthplace in Italy.　Schröter does not state which of the two he intended to honour.　**400 C d**

MARCO POLO.　1254–1324.　(M)

The famous Venetian traveller who journeyed through Central Asia to China, was welcomed by the great Mongol ruler, Kublai Khan, and entered his service, returning home after twenty-four years' absence by Java and Sumatra.　He also visited Madagascar and Zanzibar, and saw and drew "a star as big as a sack" (the Great Magellan Cloud).　When commanding a Venetian galley he was captured by the Genoese, and in prison dictated the story of his travels.　**401 F d**

MARGINIS, Mare. Border Sea. (Frz)

On west limb of Moon. **402 A d**

MARINUS. Marinus of Tyre, second century A.D. (M)

Eminent geographer, the first to represent Asia and Africa as rivalling Europe in size (though ignorant of their true shapes), thus showing that the Roman Empire was not the whole of the habitable world. His work is lost, but was utilized by Ptolemy, who adopted his method of dividing maps into "climates" to mark divisions of latitude. **403 B j**

MARIUS. Simon Mayer, 1570–1624. (R)

Born at Gunzenhausen in Bavaria, and studied astronomy under Tycho and Kepler. After three years in Italy he became Court Astronomer to the Margrave of Brandenburg. In 1609 he managed to obtain one of the newly invented telescopes from the Netherlands, and saw Jupiter's satellites. He named them, and claimed to be their discoverer; and though accused of plagiarism by Galileo, recent research has proved that he saw them first. He also first observed telescopically the Andromeda Nebula, and said it was like a candle shining through horn. **404 J de**

MARTH. Albert Marth, 1828–1897. (Kr)

Born in Kolberg, studied in Berlin, and was a pupil of Bessel at Königsberg. He was astronomical observer at Durham; later a most efficient assistant to Lassell at Malta; lastly Director of Cooper's Observatory in Markree, Ireland. For over thirty years he provided ephemerides of great value to lunar and planetary observers; and calculated orbits of comets and asteroids. He died in Heidelberg. **405 H h**

MASKELYNE. Nevil Maskelyne, 1732–1811. (Lo)

The fifth Astronomer Royal was attracted to astronomy by the solar eclipse of 1748; later he met Bradley; and his voyage to St Helena to observe the transit of Venus, 1761, determined the special work of his life, to improve navigation. He wrote the *British Mariner's Guide* explaining the method of "lunars" for determining longitude at sea, using chronometers and Hadley's quadrant, and he founded the *Nautical Almanac*. He also began the regular publication of *Greenwich Results*. **406 C e**

MASON. Charles Mason, 1730–1787. (M)

Assistant at Greenwich Observatory, where he corrected Mayer's lunar tables and helped in reducing Bradley's lunar observations: his finally revised tables were published in 1787. He observed the 1761 and 1769 transits of Venus, and surveyed hills in Great Britain to find one suitable for Maskelyne's gravity experiment. His name is familiar as that of surveyor with Jeremiah Dixon of the disputed

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boundary between Maryland and Pennsylvania (America), known ever since as the "Mason and Dixon line."   **407 D b**

MAUPERTUIS.   Pierre Louis de Maupertuis, 1698–1759.   (Schr)

Born at St Malo, served five years in the French Army, spending his leisure time in mathematical studies.   He was chief of the French expedition to measure an arc of meridian in Lapland (1736), went to Berlin (1740), and at the battle of Mollwitz was captured by the Austrians.   He was member of the French Academy, President of the Royal Academy of Science in Berlin, and Fellow of the Royal Society, London.   He wrote on Lunar Parallax, Nautical Astronomy, and the Figure of the Earth.   (*See* CONDAMINE.)   **408 G b**

MAUROLYCUS.   Francesco Maurolico, 1494–1575.   (R)

A Franciscan abbot and noted mathematician, born of Greek parents in Messina.   He was family tutor to the Viceroy of Sicily. He published tables of secants, and a treatise on conics, also translated the *Moving Sphere* of Autolycus and other Greek·mathematical works. In his astronomical writings he was a determined opponent of the Copernican system.   Riccioli calls him "clarissimum Siciliae lumen." **409 DE j**

MAURY.   Matthew Fontaine Maury, 1806–1873.   (B)

American naval officer, born in Spottsylvania, Virginia, who as lieutenant circumnavigated the globe in the *Vincennes*.   He was instrumental in founding the U.S. Naval Observatory, and was its first director; and he encouraged international co-operation in the systematic study of ocean meteorology.   His *Physical Geography of the Sea* was translated into all the chief European languages.   **410 C b**

MAYER, Chr.   Christian Mayer, 1719–1783.   (Schr)

Professor of mathematics and physics at Heidelberg University, then State Astronomer at Mannheim, where he established an observatory in the neighbourhood, at Schwetzungen.   He sought methodically for faint stars near bright ones, believing them to be satellites, and in 1777 published a list of eighty; but this novel idea met with discouraging incredulity until Herschel, in 1803, by measuring relative positions at intervals, proved that binary stars do exist.   Mayer also published work on solar and lunar eclipses.   **411 E a**

MAYER, T.   Tobias Mayer, 1723–1762.   (Schr)

Born at Marbach, Württemberg.   Son of a wheelwright, and mostly self-taught, he became draughtsman in a cartographic establishment in Nüremberg and wrote an important paper on lunar librations, based on his observations.   Later he was in charge of Göttingen Observatory, and his lunar tables were adopted and rewarded by the British Admiralty on Bradley's recommendation, as providing the first practical solution of the problem of longitude-finding at sea.

His eight-inch chart, based on careful measurements, not eye-estimates merely, was the most accurate map of the Moon for half a century, and was reproduced by Schröter in his *Selenotopographische Fragmente*. **412 H d**

MEDII, Sinus. Central Bay. (M)

At centre of Moon. **EF e**

MEE. Arthur Butler Phillips Mee, 1860–1926. (Wil)

Son of a Baptist minister in Aberdeen, where he was born, his early years were spent in Llanelly, and the rest in Cardiff, where he was assistant editor of the *Western Mail*. Throughout life he was keenly interested in astronomy, especially in Mars and the Moon, and observed them with an $8\frac{1}{2}$-in. Calver reflector. He made a number of detailed lunar drawings, and two of Mars appeared in Flammarion's *La Planète Mars*. His *Observational Astronomy* for amateurs was published in 1893 and 1897. **414 GH j**

MENELAUS. *c.* A.D. 100. (Schr)

Greek geometer and astronomer, born in Alexandria. In the first year of Trajan (98) he was in Rome, and the observations he then made of occultations of Spica and β Scorpionis were used by Ptolemy and later by Albategnius to determine the value of precession. His great work on spherical trigonometry, *Spherica*, and especially its fundamental theorem ("Menelaus' Theorem"), was a great advance on the geometrical work of Autolycus, Euclid, and Hipparchus, and was used by Ptolemy, translated into Arabic by the astronomers of Baghdad and Maragha, and into Latin in twelfth-century Europe. **415 D d**

MERCATOR. Gerard de Kremer, 1512–1594. (R)

Born at Rupelmonde, on the Scheldt, son of a poor cobbler. Educated at Louvain under Gemma Frisius, he opened a geographical office and nautical instrument shop in Antwerp for sailors. (His native and Latin name both mean "shopkeeper.") He made remarkably accurate maps, terrestrial globes, and one of the first celestial (1551); and revised Ptolemy's geographical tables. "Mercator's Projection," his invention, is familiar to all who use maps. Prosecuted for his religious opinions in 1554, he retired as professor of cosmography to Duisberg, where he died. **416 G h**

MERCURIUS. Mercury. (Legendary.) (R)

The Romans attributed to Mercury, messenger of the gods, the gift of all learning, including astronomy. Riccioli considered this myth as based on fact, admitted him to his *Chronicle of Astronomers and Cosmographers*, with date 1520 B.C., and placed him in the Moon near his mythical grandfather, Atlas. **417 B b**

MERSENIUS. Marin Mersenne, 1588–1648. (R)

Born of peasant parents in Maine (France); fellow-pupil of Descartes at La Flèche; became a Minorite friar and taught

theology in Paris. He corresponded with scientists everywhere, and contributed more than anyone to make Paris the intellectual centre of Europe: his "conférences" foreshadowed the French Academy. He made valuable contributions to the theory of numbers ("Mersenne's numbers"), and disseminated the work of other mathematicians; wrote on physics, mechanics, astronomy; carried on Galileo's work in acoustics, and experimented with parabolic reflectors. **418 J g**

MESSALA. Ma-sa-Allah (or Mashalla), died *c.* A.D. 815. (R)

Jewish astronomer and astrologer, who joined in the scientific work of the Arabs and became a Moslem. He lived under Almansur, the first Caliph of Baghdad and founder of the Baghdad school of astronomy. Messala seems to have been a surveyor for the new city in 762. Latin translations of his writings were valued in Europe and were used for teaching from the twelfth century onwards. His *De Scientia motus orbis* was printed at Nüremberg in 1504, *De Compositione et Utilitate Astrolabii* at Freiburg in 1503. **419 B b**

MESSIER. Charles Messier, 1730–1817. (M)

Born at Badonvillier, near Luneville. The total solar eclipse of July 1748 impressed him so much that he decided to be an astronomer, and studied under Delisle. He had wonderful eyesight, and was nicknamed "the ferret of comets" because he discovered so many. Nebulæ often misled him in his hunt for comets, so he drew up a catalogue of 103, and these nebulæ still bear his numbers and the prefix M. **420 B f**

METIUS. Adriaan Adriaanszoon, 1571–1635. (R)

The Latin name of this Dutch astronomer seems to refer to the mathematical gifts (*metior* = I measure) possessed by his father, brothers, and himself. He was born at Alkmaar, studied at the universities of Franeker, Leiden, Rostock, and Jena, and visited Tycho at Uraniborg. He became professor of mathematics at Franeker (Friesland), and wrote treatises on astronomy and geography, the use of the globe, astrolabe, and gnomon. His brother, Jacob Metius (died 1628), claimed to have invented the telescope. (*See* LIPPERSHEY.) **421 C j**

Riccioli gives the name as Adrianus Metius.

METON. Fl. 432 B.C. (R)

An astronomer of ancient Athens who introduced a luni-solar cycle of nineteen years, having discovered that 235 lunar months are nearly equal to 19 solar years. It is uncertain whether "Meton's cycle" was used as a calendar, or only as a standard for regulating the existing calendar when necessary. Its use spread to other parts of Greece, and is the basis of the ecclesiastical rule for fixing Easter. **422 E a**

MILICHIUS. Jacob Milich, 1501–1559. (R)

A doctor of medicine, born in Freiburg-in-Breisgau, he became professor of philosophy and then of medicine in Wittenberg University. He was the first to teach mathematics in this university (founded 1502), and Erasmus Reinhold was one of his pupils. His commentary on Pliny's *Natural History*, Book II, which concerned astronomy, was popular and many times reprinted. **423 H e**

MILLER. William Allen Miller, 1817–1870. (B)

Born at Ipswich, he became assistant lecturer to Professor Daniell at King's College, London, and his successor as professor of chemistry. When Huggins, hearing of Kirchhoff's explanation of the Fraunhofer lines, made a spectroscope and began to investigate stellar spectra in 1862, his friend Miller joined him in the work and helped to lay the foundation of stellar spectroscopy. Birt named them to commemorate their joint labours, and they are close together on the Moon. **424 E j**

MITCHELL. Maria Mitchell, 1818–1889. (Lee)

Born at Nantucket, of a Quaker family, she helped her father in astronomical observations and early showed an ability for mathematics. In 1847 her discovery of a telescopic comet won a medal from Frederick VI of Denmark and recognition from astronomers in Europe and America. She became a computer for the *American Nautical Almanac*, and also worked in her private observatory, until her appointment as professor of astronomy and Director of Vassar College Observatory. She was the first woman member of the American Academy of Arts and Sciences. **425 D b**

N.L.F. gives Schmidt as authority, in error.

MOIGNO. François Napoleon Marie Moigno, 1804–1884. (B)

Born at Guémené, in Brittany, he entered the Order of Jesuits, became Abbé, and taught mathematics in Paris. He travelled much in Europe and knew many languages, both European and Oriental, also studied physics, and worked on polarization of light and the electric telegraph. He wrote on mathematics and many other subjects, and helped to popularize science. **426 DE a**

MOLTKE. Helmuth Karl, Graf von Moltke, 1800–1891. (Kr)

Prussian field-marshal, for thirty years chief of staff of the army, and distinguished himself in the Danish, Austrian, and Franco-German wars. His name is commemorated on the Moon in recognition of his great service to selenography in promoting the publication of Schmidt's lunar map by the Prussian Government. Moltke himself did much surveying and mapping of terrestrial regions, including some parts of Asia where no other European had been since Xenophon. **427 C f**

MONGE. Gaspard Monge, 1746–1818. (Schr)

One of the creators of modern geometry, son of a pedlar at Beaune. An officer having seen a plan of a village made by him, obtained permission for him to attend surveying and drawing lessons at a military school. His work was so original that he was made professor, and in 1780 appointed to a chair of mathematics in Paris. He was Minister of Marine in the Revolution, and served with Napoleon in Egypt, and was the first to explain the mirage seen there. **428 B g**

MONTANARI. Geminiano Montanari, 1633–1687. (Fauth)

Of Modena. Was successively professor of mathematics at Bologna and of astronomy and meteorology at Padua.   He discovered the variability of Algol; he invented a primitive form of micrometer, a trellis-work of fine silver wires in the focal plane of his telescope, and was the first to apply such means to mapping the Moon. All observations for his map appear to have been made in October 1662; it was published in Malvasia's *Ephemerides novissimae motuum coelestium,* but was forgotten until it was described and reproduced in *Modena Geophysical Observatory Publications* in 1927, and in *Ciel et Terre* in 1929 and 1930. **429 G j**

MORETUS. Théodore Moret, 1602–1667. (R)

Belgian mathematician. Born at Antwerp, a member of the Plantin family of printers' fame, he entered the Order of the Jesuits, which directed a flourishing school of mathematics in the Netherlands, under Tacquet and d'Aguillon. He afterwards taught philosophy and mathematics, first in Prague, then in Breslau, and wrote on mathematics, gravity, and *De Luna Paschali et Soli motu.* In his *De Aestu maris* (Antwerp 1665) he criticized Stevin, who had attributed tides to the action of the Moon through a magnetic medium: Moretus believed that attraction alone would account for tides. **430 F k**

MORTIS, Lacus. Lake of Death. (R) **431 D b**

MÖSTING. Johan Sigismund von Mösting, 1759–1843. (M)

Statesman and patron of science and letters. He belonged to a family of the old Danish nobility, and his talents quickly opened for him a brilliant career. He became Minister of Finance and did excellent work in restoring Denmark to solvency and prosperity. Later he was Director of the Royal Library in Copenhagen. In 1821 he asked Schumacher to edit a journal in which astronomers might exchange news and views, and secured State assistance for this publication, the *Astronomische Nachrichten.* **432 F f**

MÖSTLIN. Michael Möstlin (or Maestlin), 1550–1631. (Peu)

Professor of mathematics at Heidelberg and then at Tübingen, where in addition to his teaching he wrote several works, and made astronomical observations. He mapped eleven, and is said to have

seen fourteen stars in the Pleiades cluster. He was a Copernican, though privately, and being struck by the intelligence of young Kepler, his pupil at Tübingen University, he paid special attention to his education and taught him the Copernican system: this is his chief claim to fame. **433 J e**

MOUCHEZ. Ernest Amédée Barthélémy Mouchez, 1821–1892. (Gaud)

Gazetted midshipman in the French Navy in 1839, captain in 1861, he observed a transit of Venus from the island of St Paul, and surveyed the coasts of North Africa and South America. In 1878 he was appointed Director of Paris Observatory with the rank of rear-admiral; and under his guidance old instruments were improved and new constructed, old observations reduced and published, and new departments added for spectroscopy and photography. He presided over the inaugural meeting of the Astrographic Congress. **434 F a**

MÜLLER. Dr Karl Müller, 1866–   . (Lam)

Born at Franzensbad, in Bohemia, educated in Eger and at Prague University. He held various Government posts until his retirement in 1922, and then settled near Vienna. He was always interested in natural science, and since 1895 made a special study of the Moon. Besides numerous articles, he published (in 1927) *Studies in Lunar Photography*, and is preparing a Lunar Map from König's unpublished measures. With Miss Blagg he drew up *Named Lunar Formations* for the International Astronomical Union. **435 E f**

MURCHISON. Sir Roderick Impey Murchison, 1792–1871. (B)

Born at Tarradale, Scotland, and educated in a military college, he was with Wellesley in Spain and took part in Sir John Moore's retreat to Corunna. Through Sir Humphry Davy he became interested in geography and geology; to his researches in Wales is due the term "Silurian System"; he wrote important papers on Alpine geology, and with Keyserling and de Verneuil *Russia and the Ural Mountains*. He was one of the founders of the Royal Geographical Society in London, and established a chair of geology in Edinburgh. **436 EF e**

MUTUS. Vincente Mut (or Muth), *d.* 1673. (R)

A pilot and navigator in the Balearic Islands, he observed in Majorca from 1642 onwards several lunar eclipses, from which he deduced the longitude of Palma; also conjunctions of planets with stars, and the comet of 1664, which was first seen in Spain. He published *Tractatus de Sole Alphonsino* (Majorca, 1644) and *Observationes motuum coelestium* (1666). Riccioli calls him an expert astronomer and sedulous observer of stars, to whom he himself owed much. **437 D k**

NASIREDDIN. Nasir-al-Din, 1201–1274. (M)

Persian astronomer, born at Tus, in Khorassan. Hulagu Khan, grandson of Genghis Khan, made him Vizier, and ordered to be built,

equipped, and staffed for him a splendid observatory at Maragha. Nasireddin and his assistants translated Greek writings on astronomy and geometry, and wrote others; developed trigonometry; determined the value of precession at 51″; and drew up the Ilkhanic Tables, including a star catalogue. When he died, soon after the Khan, his school died also. **438 EF j**

NASMYTH. James Nasmyth, 1808–1890. (Gaud)

Scottish engineer, inventor of the steam-hammer. From an early age he studied astronomy, and in 1827 constructed a six-inch reflecting telescope. On retiring from business he lived at Penshurst, Kent, where he observed and described the "willow-leaf" mottling of the Sun's disc. With Carpenter he made drawings of lunar regions under various conditions of illumination, from which they constructed models and, after comparison with the originals, photographed them for illustrating their book *The Moon* (1874). **439 H j**

NAUMANN. Karl Friedrich Naumann, 1797–1873. (Smt)

German geologist, born in Dresden. In 1821–1822 he carried out a scientific expedition in Norway, and published his results. He was professor of crystallography in Freiburg in 1826, and later of geology also; then for nearly thirty years pursued his research work in Leipzig; but his last two years were spent in Dresden. His *Geognostische Karten* and *Elemente der Mineralogie* are well known. **440 J c**

NEANDER. Michael Neumann, 1529–1581. (R)

Born in the Joachimsthal, on the Bohemian side of the Erz Gebirge. A well-known Renaissance scholar, he became professor of mathematics and Greek, and later of medicine, at Jena. Author of an important and scholarly work on metrology, *Synopsis mensurarum et poderum*, Basle, 1555; also of works on spherics and mathematical astronomy. **441 C h**

Another Michael Neander, 1525–1595, wrote on physics and theology, but that Riccioli meant the above is clear from his Chronicle of Learned Men in *Alm. Nov.*

NEARCH. Fl. 325 B.C. (N)

A friend of Alexander the Great, and companion on his Asiatic campaigns. He commanded the fleet which Alexander built on the Hydaspes, and brought it from the Indus to the Tigris while Alexander marched overland. Nearch wrote a detailed account of the voyage, describing the coast lands and their inhabitants, and his encounter with whales, when the ships charged in battle array, sounding their trumpets. **442 D k**

NEBULARUM, Palus. Misty Marsh. (R) **E bc**

NECTARIS, Mare. Sea of Nectar. (R) **444 C g**

NEISON. Edmund Neison (name changed to Nevill), 1851– . (Lam)

Born in London, Fellow of the R.A.S. from 1873, and communicated to *Monthly Notices* and other periodicals many astronomical papers, especially on lunar theory. In 1876 he published *The Moon*, with two-foot map and drawings of special regions. It was based on Beer and Mädler, but much new material was added from his own observations, made during many years, chiefly with a six-inch refractor, also from the work of Schröter, Schmidt, Birt, Webb, and others. From 1882 he was director of the newly founded Natal Observatory at Durban till it ceased to be a Government observatory in 1910. **445 E a**

NEPER. John Napier, 1550–1617. (Schr)

Famous as the inventor of logarithms in 1614, the use of which rapidly spread in England and elsewhere. Most of his life was spent on the family estate of Merchistoun, near Edinburgh, and as an ardent Presbyterian he took an active part in the religious and political controversies of his day, the study of mathematics and science being his favourite amusement. **446 A e**

NEUMAYER. Georg Balthasar von Neumayer, 1826–1909. (Smt)

Born at Frankental, in Bavaria, studied science in Munich and navigation under Rümker in the Hamburg Nautical School. He travelled to Australia in 1852 and discovered Heard Island: the scientific results of this voyage were published by the English Government, and he was made Director of the Flagstaff Observatory in Melbourne and wrote on the meteorological and magnetic observations made there. In 1872 he was hydrographer, then director, of the Hamburg Marine Institute, and published weather charts and reports. After retiring he wrote his guide for scientific travellers. **447 D k**

NEWCOMB. Simon Newcomb, 1835–1909. (N)

Born in Nova Scotia, graduated at Harvard, was professor of mathematics in the U.S. Navy, later head of the American Nautical Almanac Office. His chief work was mathematical astronomy: he investigated the orbits and origin of the asteroids, distance of the Sun, motions and masses of Neptune and Uranus. For the lunar theory he visited Paris Observatory, searched for and studied the seventeenth-century observations made there, and thus carried back his calculations much further than had been done before. Of his books *The Stars* is one of the best known. **448 BC c**

NEWTON. Isaac Newton, 1643–1727. (M)

Born near Grantham, Lincolnshire, he entered Trinity College, Cambridge, was elected a Fellow, and spent most of his life there. His most important work dealt with astronomy, including dynamics, optics, and pure mathematics, and his three great discoveries were: the law of universal gravitation, first applied to the Moon; the resolution of white light into colours with a prism; and his theory of

fluxions. Halley persuaded him to publish his *Principia* in 1687.
449 F k

NICOLAI. Friedrich Bernhard Gottfried Nicolai, 1793–1846. (M)

Born in Brunswick, he became assistant in Seeberg Observatory (Gotha), then from 1816 until his death Director of Mannheim Observatory. He is principally known for his work on comets, having calculated orbits for twenty-six, including Pons' comet of 1812 and Olbers' of 1815. He also derived Jupiter's mass from perturbations of Juno, and wrote on the possible existence of a planet beyond Uranus, and on methods of finding longitudes by lunar distances of stars and lunar culminations. **450 D j**

Mädler in giving the name refers to Nicolai as Director of Mannheim Observatory.

NICOLLET. Jean Nicholas Nicollet, 1788–1843. (N)

Assistant at Paris Observatory, known chiefly for his lunar work. He reduced Bouvard's measures of the crater Manilius, and combining them with his own obtained a very accurate position. (*See* MÄDLER.) From the observations he deduced values for a physical libration of the Moon and the inclination of her equator. Later he went to America, and is believed to have written the sensational book on the Moon which was published under John Herschel's name and deceived many readers. **451 FG g**

NÖGGERATH. Jacob Nöggerath, 1788–1877. (Smt)

Born in Bonn, and became professor of mining and metallurgy at the university there, and inspector of mines to the Government. He wrote much on mineralogy and geology and allied subjects, including works on earthquakes and landslides, the formation of mountains, fossil trees, and mammoths. **452 H j**

NONIUS. Pedro Nuñez, 1492–1577. (R)

Portuguese professor of mathematics at Coimbra, who was the first to suggest a method of subdividing arcs to obtain more precise measurements with astronomical instruments. It was called the Nonius, but though ingenious it was not practical. Tycho found his transversals better, and in 1631 Vernier invented the excellent method still in use. Nonius also wrote *De Crepusculis*, in which problems of the duration of twilight and its variation in different latitudes are correctly solved. **453 E h**

NOVUM, Mare. New Sea. (Frz) **A c**

NUBIUM, Mare. Sea of Clouds. (R) **G gh**

OENOPIDES. Oenopides of Chios, *c.* 500–430 B.C. (R)

Greek astronomer and geometer, said by Proclus to have been a little younger than Anaxagoras. He studied geometry in Egypt, where he lived for some time, and is credited with solving the two

problems of Euclid I, 12 and 23. He is also believed on good authority to have discovered that the Sun's path in the zodiac is inclined to the celestial equator. **456 H a**

OERSTED. Hans Christian Oersted, 1777–1851. (M)

Danish electro-magnetist and philosopher, professor of physics in Copenhagen, who did much towards the invention of electric telegraphy. He was born in Rudkjobing, in Langeland, and travelled much in foreign countries, was a member and from 1815 secretary of the Royal Danish Society of Science, also member of the French Académie des Sciences. **457 C b**

OKEN. Lorenz Oken (more correctly, Okenfuss), 1779–1851. (M)

Born in Bohlsbach (Baden), he became professor of natural history in Jena and in 1817 founded the encyclopædie journal *Isis*; but becoming involved in difficulties through some political articles he left Jena, spent five years in Munich, then went to Zürich, where he died. He was well known as a nature philosopher of the Romantic Movement, and a naturalist, and his text-books were much esteemed. Through his influence the first conference of naturalists and physicians was held. **458 B j**

OLBERS. Heinrich Olbers, 1758–1840. (M)

Born in the village of Arbergen, where his father was pastor, he settled in the neighbouring city of Bremen as a doctor, and continued in active practice for over forty years; but he was also a keen astronomer, and devoted his spare time especially to comets, discovering and observing many, and inventing "Olbers' method" for calculating their orbits. He also discovered the second and fourth asteroids, Pallas and Vesta, and wrote numerous important papers in scientific periodicals. **459 K e**

OLIVIUM, Prom. Olive Promontory. (*See* LAVINIUM.) (B) **460 B d**

OPELT. Friedrich Wilhelm Opelt, 1794–1863. (Smt)

He was born in Rochlitz (Bavaria), became a successful financier in Saxony, and was private financial adviser to the State; he died in Dresden. He helped Lohrmann with his work on the Moon, for Schmidt, when editing Lohrmann's *Mondkarte* (Leipzig, 1878), mentions Opelt as part author. He also translated into German, with notes and additions, Francoeur's *Traité élémentaire de Mécanique.* **461 G g**

OPPOLZER. Theodor von Oppolzer, 1841–1886. (Kr)

His great work, the *Canon of Eclipses*, containing every solar and lunar eclipse between 1203 B.C. and A.D. 2163, was finished shortly before his early and sudden death; but even before graduating as doctor of medicine at Vienna he had published a treatise on the orbits of fifty-six asteroids. Later he wrote a text-book on *Orbit Determinations of Comets and Planets.* He was professor of astronomy

and geodesy in Vienna, and had a private observatory, where he studied the lunar theory and compiled *Tables of Lunar Syzygies and Eclipses*. His birthplace was Prague.   **462 F f**

ORIANI.   Barnabo Oriani, 1752–1832.   (M)

Born at Garegnano, near Milan, of very poor parents; but the Certosan fathers there, seeing the boy was clever and eager to learn, sent him to school in Milan, and he became abbot and astronomer, entering Brera Observatory in 1776.   His chief work was in celestial mechanics and astronomy of position, also geodesy; and he computed the orbits of the newly discovered planets Uranus and Ceres.   He and his friend Piazzi corresponded for thirty-five years, and among his pupils were Carlini, Plana, and Inghirami.   **463 A c**

ORONTIUS.   Orontius Finaeus, 1494–1555.   (R)

Like Tycho Brahe, this French mathematician is generally known by his first name.   For six years he was imprisoned because of opposition to the Concordat; afterwards he taught mathematics privately, and then was appointed professor in the college founded by Francis I which developed into the Collège de France.   He wrote on arithmetic, geometry, optics, cosmography, dials, astrolabes, and methods of determining longitude by lunar observations, in all thirty-four works, and designed a planetary model.   He was born in Briançon, but lived and died in Paris.   **464 F j**

PALISA.   Johann Palisa, 1848–1925.   (Kr)

Born in Troppau (now Opava), studied at Vienna University, became assistant in the observatory there under Littrow and Weiss, and later director at Pola, where he specialized in observing asteroids.   Returning to Vienna, he made maps for this work, renouncing his early method of plotting from observation and following Wolf's rapid and successful method of photography.   These maps included fainter stars than Chacornac's.   His first asteroid, discovered in 1874, he called Austria; his 127th he found a few months before his sudden death in Vienna.   **465 F f**

PALITZSCH.   Johann Georg Palitzsch, 1723–1788.   (Schr)

A farmer in Prohlis, near Dresden, who spent what he earned on books and instruments, learned mathematics and trigonometry, and observed with his own telescope.   He studied Clairaut's prediction of the return of Halley's comet, and was the first to find it, on December 25, 1758.   He also studied physics and botany, and had rare foreign plants in his garden.   Prince Heinrich, brother of Frederick II, visited him and gave him Buffon's *Natural History*. He continued to work on his farm to the end.   **466 A h**

PALLAS.   Peter Simon Pallas, 1741–1811.   (M)

German naturalist and explorer, born in Berlin.   At the invitation of the Empress Catherine he went to St Petersburg, and made

various journeys of exploration through Russia and Siberia. In 1769 he was appointed naturalist to a scientific expedition to Siberia to observe the transit of Venus; and in 1772 he found on a mountain-top south of Krasnoyarsk a mass of meteoric iron weighing 1500 lb., which was named after him the "Pallas meteorite." He died in Berlin. **467 F e**

PALMIERI. Luigi Palmieri, 1807–1896. (Smt)

Italian mathematician and physicist, who made a special study of earthquakes and volcanic phenomena, and invented instruments for this purpose. He also wrote many works on electricity. He was born at Faicchio, near Benevento in South Italy, was appointed professor of physics in 1847 at Naples University, and Director of the Meteorological Observatory on Vesuvius in 1848. He died in Naples. **468 J h**

PARROT. Johann Jacob Friedrich Wilhelm Parrot, 1792–1840. (M)

Born at Karlsruhe but spent most of his life in Russia, and was staff surgeon to the Russian Army in the 1815 campaign. In 1821 he became professor of physiology and pathology at Dorpat, and in 1826 succeeded his father there as professor of physics. He made many explorations in South Russia, the Caucasus, and the Pyrenees, and ascended Mt Ararat. **469 E g**

PARRY. Sir William Edward Parry, 1790–1855. (M)

English admiral and Arctic explorer. He accompanied Sir John Ross's expedition (1818) for discovery of the N.W. Passage, and commanded an expedition himself in 1819, winning the Government prize when he crossed longitude 110° W. His record in reaching latitude 82° 45′ N. was unsurpassed for nearly fifty years. He was born at Bath, and died at Ems, in Germany. **470 G f**

PARVUM, Mare. Little Sea. (Frz) **J j**

PEIRCE. Benjamin Peirce 1809–1880. (N)

American mathematician and astronomer, born at Salem, Massachusetts. He became professor of mathematics at Harvard in 1833 and of astronomy in 1842, and is remembered as an inspiring teacher. Among his astronomical researches are those on Saturn's rings and the perturbations of Uranus and Neptune. **472 B d**

PEIRESCIUS. Nicolas Claude Fabri de Peiresc, 1580–1637. (Smt)

Scholar, naturalist, archæologist, and amateur astronomer of Provence, who by his correspondence and many friendships greatly influenced the learning of his time. He published nothing, but he discovered the Orion Nebula in 1610, and he instigated observations from Marseilles to Aleppo of a lunar eclipse, thereby proving the Mediterranean to be shorter by 1000 km. than the length based on Ptolemy's longitudes and generally accepted by scholars, although

the *Alphonsine Tables* gave a truer value. He measured the Sun's altitude at Marseilles at the solstice to compare with the estimate of Pytheas. **473 B j**

PENTLAND. Joseph Barclay Pentland, 1797–1873. (M)

An Irishman who went to Paris and thence to Peru as secretary to the French Consulate, and became Consul-General in Bolivia in 1836. He surveyed part of the Bolivian Andes, and found Silurian and Carboniferous fossils at great heights; discovered the outlet of Lake Titiaca; and explored ancient sites in Peru. From 1845 he wintered in Rome and travelled much in Italy; he died in London. **474 E k**

PETAVIUS. Denis Petau, 1583–1652. (R)

French chronologist, born at Orleans. He lectured on philosophy at Bourges, and, after becoming a Jesuit, on theology at Rheims and Paris. Besides writing on theology and chronology, he collected and translated astronomical works by Geminus, Hipparchus, and other ancient Greek writers; and he studied the risings and settings of stars and the effects of precession of the equinox for the light they may throw on research into ancient astronomy. He died in Paris. **475 AB h**

PETERMANN. August Petermann, 1822–1878. (Smt)

German geographer, born at Bleicherode (near Erfurt). He founded a cartographical institute in London and managed it for seven years; then joined the geographical institute of Justus Perthes in Gotha, and edited their *Mittheilungen*. Through his efforts, and aided by his knowledge and organizing ability, several expeditions were sent out to Africa, and one to the Arctic. **476 D a**

PETERS. Christian August Friedrich Peters, 1806–1880. (B)

Born in Hamburg, and when only twenty surveyed the Territory under Schumacher's direction. He studied astronomy under Bessel at Königsberg, and also observed in Hamburg and Pulkovo. Afterwards he was Director of the Altona Observatory, and in 1872 transferred it to Kiel. His most important published works were on his geodetic surveys, nutation, and stellar parallax. In 1851 he proved that the motion of Sirius could only be explained (as Bessel had suggested) by the presence of an unseen companion, both revolving round their common centre of gravity. **477 E a**

Another PETERS (C. H. F., 1813–1890) discovered forty-eight asteroids; but he was scarcely known when Birt gave the name, in or before 1863.

PHILLIPS. John Phillips, 1800–1874. (B)

A geologist, whose many writings helped to popularize the science. He was professor in Dublin and at King's College, London, and President of the Geological Society. He played a prominent part in the formation of the British Association and edited their reports for

many years, was on their Lunar Committee, and co-operated with Birt
in lunar work. A keen observer of Mars, he produced the third
Martian map (Mädler's and Kaiser's being earlier). **478 A h**

PHILOLAUS. Late fifth century B.C. (R)

Greek philosopher of the Pythagorean school, the first to assert
Earth's motion, and sometimes supposed to have anticipated
Copernicus. But in his system Earth, Sun, and Moon, planets and
star sphere, all revolved round a Central Fire. Earth "being one of
the stars" had a twenty-four-hour period, which explained day and
night and the daily apparent revolution of all other heavenly bodies,
while the Sun's period was one year, the Moon's one month, Mars
about two years, and so on. **479 F a**

PHOCYLIDES. Johannes Phocylides Holwarda (Jan Fokker), 1618–1651. (M)

Dutch astronomer, born at Holwerd in Friesland, professor at
Franeker University. He published a treatise on astronomy in Dutch,
in which, sixty-six years before Halley's pioneer work on the subject,
he expressed the belief that stars have proper motions; but he is best
known by his rediscovery in 1638, during a total eclipse of the Moon,
of the variable star Mira Ceti. It had been discovered by Fabricius
(1596) and observed by Schickard (1631), but Phocylides first
recognized the periodic nature of its variation. **480 H kj**

PIAZZI. Giuseppe Piazzi, 1746–1826. (M)

Born at Ponte in the Valtelline, became a Theatine monk at
eighteen, and taught science and theology in Italy and Malta, then
accepted the chair of mathematics at Palermo. The Viceroy of
Sicily, Prince Caramanico, built an observatory for him in a tower
of his old Saracenic palace, while Piazzi studied practical astronomy
under Lalande and Maskelyne and returned with a beautiful Ramsden
circle, with which he measured star positions for his catalogue. He
discovered the first asteroid, Ceres, named after the tutelary goddess
of Sicily. **481 J hj**

PIAZZI SMYTH. Charles Piazzi Smyth, 1819–1900. (B)

Son of Admiral Smyth, born at Naples and named after the
astronomer Piazzi. He was Astronomer Royal for Scotland, carried
out researches in spectroscopy, also wrote extensively on the Great
Pyramid. His "astronomer's experiment," the first of its kind, of
ascending the Peak of Teneriffe with a telescope and observing there
for many months to test the advantages of high altitudes, interested
all astronomers and was Birt's reason for commemorating his name.
482 F b

PICARD. Jean Picard, 1620–1682. (Schr)

Born in Anjou, he took orders and became Abbé. He helped
Gassendi in astronomical observations, and afterwards succeeded

him at the Collège de France. He was appointed to Paris Observatory under Cassini, and with Auzout introduced improvements in the instruments and methods of observing, including the systematic use of telescopic sights; and he founded the *Connaissance des Temps*. His measurement of an arc of meridian in France, giving a value of Earth's radius more accurate than any previously obtained, was used by Newton in working out his theory of gravitation. **483 B d**

PICCOLOMINI. Alessandro Piccolomini, 1508–1578. (R)

Archbishop of Sienna and member of an ancient illustrious family. He wrote a book on planetary theory, also *La Sfera del Mondo*, and *Delle Stelle*, which describes the constellations and is illustrated by forty-eight star-maps. In these the stars were distinguished for the first time by (Latin) letters, afterwards superseded by Bayer's Greek letters. The books were written in Italian, not as then usual in Latin, and were very popular. **484 C h**

PICKERING, E. Edward Charles Pickering, 1846–1919. (Kr)

Born at Boston, U.S.A., from 1876 Director of Harvard Observatory. In addition to personal research, his great work was to build up a staff so equipped and organized that through their joint labours the whole heavens were surveyed (from Harvard and the southern station at Arequipa) and stellar magnitudes and spectra tabulated in *Harvard Photometry* and *The Draper Catalogue*; also that the skies were (and still are) photographed automatically every night, and the plates stored as a reference library. The *Harvard Annals* also record many special researches and discoveries. **485 E f**

PICKERING, W. H. William Henry Pickering, 1858–1938. (Com)

Brother of the above, and assistant at Harvard. In 1891 he supervised the erection of Arequipa Observatory, and began his lunar studies there, continued them in Jamaica, and published *The Moon*, containing a complete photographic atlas and summary of his observations. He considered there were evidences for a tenuous atmosphere, slight remains of volcanic activity, and some kind of vegetation. He also observed and photographed Mars, and suggested that the "canals" are vegetation bordering waterways. He discovered the 9th satellite of Saturn. **486 B f**

PICO, Mt. (Schr)

Schröter doubtless means the "Pico von Teneriffa" (Peak of Teneriffe), with whose height he compares the heights of lunar mountains (*Selenotopographische Fragmente*, par. 170.) **487 E b**

PICTET. Marc Auguste Pictet, 1752–1825. (M)

Swiss astronomer and naturalist, who was born, and died, at Geneva. He was Director of Geneva Observatory, and carried out researches in fundamental astronomy, geology, and the gases of the atmosphere. **488 F j**

PIETROSUL, Bay. (Kr)

A mountain of Hungary (now in Rumania). **489 G d**

PINGRÉ. Alexandre Guy Pingré, 1711–1796. (N)

Born in Paris, studied and taught theology, but when nearly forty took up astronomy, first in Rouen, then Paris; observed the transit of Mercury at Rouen in 1753 and two transits of Venus at Rodriguez and San Domingo; made three voyages to test marine chronometers, the last with Borda. He wrote a survey of astronomical observations in the seventeenth century, and a comprehensive work on comets, *Cométographie*, including records of all that he could trace: the latest was Uranus, just discovered by Herschel and thought to be a comet. **490 H k**

PITATUS. Pietro Pitati, sixteenth century (R)

Mathematician and astronomer of Verona, who published ephemerides for 1552 to 1624 for use in Venice, which were based on the *Alphonsine Tables*, and were valuable in astronomy and navigation. Like several others, in this and the preceding century, he urged upon the Pope (in 1537) the need of calendar reform; and he wrote an *Explanation of the Rising and Setting of the Fixed Stars*, printed at Basle, 1568. **491 FG h**

PITISCUS. Bartholemaeus Pitiscus, 1561–1613. (R)

Theologian and mathematician, born at Schlaune, in Silesia, professor of mathematics and for many years Court Chaplain in Heidelberg. His name is famous for his *Thesaurus Mathematicus* (Frankfort, 1613), which was a new edition of Rhæticus' *Tables of Sines* with additional 25-figure tables of his own for the first 6 degrees. His *Trigonometria* includes three chapters on astronomical problems. He died in Heidelberg. **492 D j**

PITON, Mt. (B)

Named from a peak in Teneriffe, to commemorate the astronomical expedition thither. (*See* PIAZZI SMYTH.) **493 F b**

PLANA. Giovanni Antonio Amadeo Plana, 1781–1864. (M)

Born at Voghera in Italy but educated in Paris, this nephew of Lagrange was nominated professor of mathematics and Royal Astronomer at Turin, where he died. His lunar theory was a great advance on all preceding work, and won a prize from the French Institute and the Gold Medal of the R.A.S. His other investigations include the long inequality of Jupiter and Saturn, the Earth's density, and atmospheric refraction. **494 D b**

PLATO. *c.* 427–347 B.C. (R)

Great Greek philosopher, a pupil of Socrates for eight years, travelled and studied mathematics and philosophy in Cyrene and probably Egypt, in Sicily and Italy, where he met the Pythagoreans

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Timaeus and Archytas. Returning to Athens, he founded his Academy of students, and developed his doctrine of the "Ideas." His philosophy and also his geometry had an immense influence on his contemporaries and successors. His astronomy is that of the Pythagoreans, and he describes the spherical Earth surrounded by planetary and stellar spheres in several of his Dialogues. **495 F b**

PLAYFAIR. John Playfair, 1748–1819. (M)

Born at Benvie in Forfarshire, and succeeded his father as minister of the parish. Later he resigned to become Ferguson's tutor, and in 1785 was appointed professor of mathematics in Edinburgh. He wrote on mathematics and physics, but is chiefly known by his able exposition and defence of Hutton's uniformitarian theory of geology, against the Catastrophists, which prepared the way for Lyell. **496 E gh**

PLINIUS. Pliny the Elder, *c.* A.D. 23–79. (R)

Author of the *Historia Naturalis* in thirty-seven books, which includes descriptive astronomy and meteorology, botany, zoology, and geography, and was a standard work for many centuries. In his youth Pliny fought in a German campaign, then became a pleader, but retired to his estate in Como to write. He lost his life in the eruption of Vesuvius which overwhelmed Pompeii. **497 D d**

PLUTARCH. *c.* A.D. 46–*c.* A.D. 120. (R)

Greek biographer, born in Chaeronea, in Boeotia. He studied philosophy in Athens, and lectured on it in Rome, but finally returned to his birthplace and became a magistrate and a priest there. His finest work is his *Parallel Lives* of Greeks and Romans. In his dialogue *The Face of the Moon* the speakers quote many of the old astronomers, and argue about the various ideas held on the nature of the Moon and her markings, discussing whether or not she is a world like the Earth. **498 A c**

POISSON. Siméon Denis Poisson, 1781–1840. (M)

Much against his will he was destined by his father to be a doctor, but he was a born mathematician, and having written a memoir on finite differences when only eighteen, he was made a school lecturer, and afterwards obtained various scientific posts and professorships. Lagrange and Laplace were his friends through life. His numerous treatises were chiefly on applied mathematics, and in astronomy his most important work was on the secular inequalities of planetary movements and the libration of the Moon. **499 E h**

POLYBIUS. *c.* 204–*c* 122 B.C. (M)

Greek historian and statesman of the Achaean League. After the Roman conquest of Macedonia he was taken with other hostages from southern Greece to Rome, but won the friendship of Scipio Africanus, went with him to Carthage, Egypt, and Spain, also had

access to the Roman archives, and on his final return to Greece wrote his *History*. Parts of this valuable work have survived. At the age of eighty-two he died from a fall from his horse. **500 CD g**

PONS. Jean Louis Pons, 1761–1831. (M)

The discoverer of thirty-six comets, an unequalled performance. He was born at Peyre, Hautes Alpes, and entered Marseilles Observatory in 1789 as concierge, took lessons in astronomy from successive directors, and made telescopes for himself, including lenses, with which he won a name throughout Europe for his discovery of comets. In 1813 he was appointed assistant astronomer, and in 1819 left Marseilles to be director of the new observatory at Marlia, near Lucca; finally was Director of the Museum Observatory in Florence, where he died. **501 D h**

PONTANUS. Giovanni Gioviani Pontano, 1427–1503. (R)

His attention seems to have been drawn to astronomy by a comet which he saw in his youth, and he translated one of Ptolemy's lesser works, the *Karpos* (usually known as the *Centiloquium*), into Latin. His two astronomical poems, *Urania* and *Meteora*, written according to Riccioli in exceedingly elegant Latin verse, were greatly admired. He was born in Spoleto, but lived and died in Naples. **502 D h**

PONTÉCOULANT. Philippe Gustave Doulcet, comte de Pontécoulant, 1795–1874. (M)

French mathematician, who devoted himself after retiring from the army to celestial mechanics. His calculation of the 1835 return of Halley's comet was correct within three days; and his *Théorie Analytique du Système du Monde*, dealing with lunar and planetary theories, was the most complete that had appeared at the time (1846). He was born at Caen and died in Paris. **503 C k**

POSIDONIUS. 135–51 B.C. (R)

Greek philosopher, geographer, astronomer; born in Syria, studied at Athens, travelled all over the Mediterranean, and in Spain observed the Atlantic tides and proved their connection with the Moon. Finally he settled in Rhodes, where he was head of the Stoic school and ambassador to Rome in 86. He estimated Earth's circumference from observations of Canopus, which was just visible in Rhodes and rose several degrees at Alexandria: his result was somewhat less than that of Eratosthenes, and probably equalled 23,700 English miles. **504 CD c**

PRINZ. Wilhelm Prinz, 1857–1910. (Kr)

Born at Mülheim, near Cologne, and was early left a poor orphan. At sixteen he went to Brussels, and while supporting himself with difficulty spent his spare time studying in the Natural History Museum. A post was procured for him there in the Geology Department, and later in Brussels Observatory. He was specially interested in the

Moon, comparing lunar and terrestrial surfaces, and was a successful pioneer in making enlargements of Lick positives. He wrote articles for astronomical and geological journals, especially for that of the Société Belge d'Astronomie. **505 J c**

PROCELLARUM, Oceanus. Ocean of Storms. (R) **506 J def**

PROCLUS. A.D. 410–485. (R)

The last great philosopher of the Neo-Platonic school, and a mathematician. His home was in Lycia, but he lived and taught in Athens, where he was greatly admired for his talents and virtues. Some of his writings, especially *The Sphere* and the commentary on Plato's *Timaeus*, contain references to early astronomers and astronomical theories which are of value to the historian. **507 B d**

PROCTOR. Mary Proctor, 1862–   . (Com)

Daughter of the astronomer Richard A. Proctor, she adopted astronomy as her life-work, and has done much to rouse interest in it, by lectures in the U.S.A., Canada, England, Australia, and New Zealand, numerous articles in astronomical journals, and sixteen books, including *The Romance of the Moon*. She witnessed total eclipses of the Sun in Norway, 1896; U.S.A., 1900; Spain, 1905; from aeroplane in England, 1927; in Canada, 1932; and the Mediterranean, 1936. **508 F j**

PROTAGORAS. *c.* 481–*c.* 411 B.C. (Smt)

A celebrated Sophist philosopher, who has the title-rôle in one of Plato's Dialogues, and whose maxim it was that "Man is the measure of all things." He was born in Thrace, and taught in Athens, where he was popular and much admired for his skill in rhetoric; but his book *On the Gods* caused his exile. **509 E a**

PTOLEMAEUS. Claudius Ptolemaeus (Ptolemy), *c.* A.D. 130. (R)

Nothing is known of his life except his work, done in Alexandria. He was the last of the great Greek astronomers, and summarized what Hipparchus and others had done before him in his *Syntaxis Mathematike*, generally known as *Almagest*. He accepted the view of Earth as stable centre of the Universe, and worked out a complete system of epicycles and excentrics to represent the observed movements of the heavenly bodies, drew up a catalogue of stars based on that of Hipparchus, and when studying the Moon's motions discovered the evection. For fourteen centuries his authority was paramount in astronomy. **510 EF f**

PUISEUX. Pierre Puiseux, 1855–1928. (Kr)

Son of a French mathematician, who taught him to love science. From the École Normale he went to Paris Observatory, and with Loewy constructed the equatorial coudé and took more than 6000 lunar photographs, which he enlarged for the *Lunar Atlas*: he also

wrote the text. He was an ardent mountain climber and ascended Mont Blanc alone. He compared terrestrial and lunar mountains and discussed their formation, also the oscillation of the Moon about its centre of gravity and its secular acceleration. **511 H h**

PURBACH. Georg von Peuerbach, 1423–1461. (R)

Born at Peuerbach (Bavaria); studied in Vienna; visited German and Italian universities, staying with Cardinal Nicolas of Cusa in Rome. (*See* CUSANUS.) Returning to Vienna, he founded a new school of astronomy, made observations, compiled tables, and began to write an *Epitome of Astronomy* based on Arabic translations of Ptolemy's *Almagest*. Cardinal Bessarion invited him and his pupil, Regiomontanus, to Italy, to learn Greek and study Ptolemy in Greek MSS., lately brought from Constantinople. On the point of starting, Purbach died. **512 F h**

PUTREDINIS, Palus. Putrid Marsh. (R) **E c**

PYRENEES, Mts. (M) **514 B g**

PYTHAGORAS. Died *c.* 500 B.C. (R)

Ionian Greek who founded a school of philosophy and science in South Italy. Theories developed by late disciples are often attributed to him; but he may be regarded as the first to maintain that Earth is not flat but spherical, at the centre of a spherical universe which rotates daily. He seems also to have studied the peculiar movements of the planets. Number, or Harmony, he thought to be the essence of all things, and compared the celestial periods with intervals in music. **515 GH a**

PYTHEAS. Pytheas of Marseilles, *c.* 350 B.C. (R)

Greek navigator who sailed so far north that the Sun rose again two or three hours after setting. Of his writings describing his voyages only fragments now remain: he visited Britain and an island six days' sail further north (the Shetlands?), and coasted along Gaul and Germany till he reached a river (the Elbe?). He was the first Greek to connect the tides with the Moon; and in Massalia (Marseilles) he measured the height of the midday sun at the summer solstice with a gnomon. **516 G d**

RABBI LEVI. Levi ben Gershon, 1288–1344. (R)

Spanish Jew, philosopher, mathematician, and astronomer. He invented the cross-staff for measuring diameters of Sun and Moon, probably from a similar instrument described by Hipparchus, and the camera obscura for observing the Sun without injuring the eyes. He drew up tables from his observations of new and full moons and eclipses, instead of relying entirely upon the *Alphonsine Tables*, which he showed to be erroneous. "Scientiarum omnium plenus, et Astronomiae studiosissimus," says Riccioli of him. **517 D h**

RAMSDEN. Jesse Ramsden, 1735–1800. (M)

Born at Salterhebble, in Yorkshire, and apprenticed to a London instrument maker, he became famous for his finely divided circles and telescope mountings for astronomical work. With an altazimuth of his construction Piazzi of Palermo made the observations for his star catalogue of nearly 8000 stars. His meridian circles were the first to be illuminated through the hollow axis. **518 H h**

RÉAUMUR. René Antoine Ferchault de Réaumur, 1683–1757. (M)

French physicist, born at La Rochelle and educated at the Jesuit College of Poitiers. He made discoveries useful in industry, notably a method of producing steel from iron, for which he received a reward of 12,000 livres and gave it to the Académie des Sciences for research work. In 1731 he constructed the "Réaumur thermometer" with temperature scale of 80° between freezing and boiling points of water. This was much used formerly, but has been superseded by the Centigrade and Fahrenheit. **519 F f**

REGIOMONTANUS. Johann Müller, 1436–1476.

Born in Bavarian Königsberg, whence he derived his Latinized name. Pupil of Purbach at Vienna, and undertook with him to revise the *Alphonsine Tables*. After Purbach's death, Regiomontanus went to Italy, mastered Greek, and completed Purbach's unfinished *Epitome of Astronomy*, also wrote a treatise on trigonometry. With his pupil and patron, Walther, he founded at Nüremberg the first modern European observatory, set up a printing-press, and published ephemerides, including data for finding longitudes at sea by "lunar distances." He died in Rome, summoned thither to assist in reforming the calendar. **520 EF h**

RÉGNAULT. Henri Victor Régnault, 1810–1878. (Smt)

Born in Aix-la-Chapelle, he became a professor in Lyons and later in the Collège de France, and a member of the Académie des Sciences. He did valuable research work in organic chemistry and also in physics, especially as applied to steam-engines. **521 HJ b**

REICHENBACH. Georg von Reichenbach, 1772–1826. (M)

German artillery officer, born at Durlach in Baden, who made improvements in the theodolite and transit-instrument. In 1804 he founded, with Utzschneider, the Optical and Mechanical Institute in Munich, where Fraunhofer joined him two years later, and the firm made instruments for many of the leading observatories of Europe. **522 B h**

REIMARUS. Nicolai Reymers Bär (or Ursus), *d.* 1600. (Smt)

Born at Dirmarschen in Holstein, of very poor parents, but contrived to learn science and classics, and published a Latin grammar and a book on geodesy. He visited Tycho in 1584, and in 1588 wrote

Fundamentum Astronomicum, which contained a description of a world-system so much like Tycho's that Tycho accused him of plagiarism, and a prolonged quarrel ensued. He was an able mathematician, and in 1597 was professor of mathematics in Prague. **523 C j**

REINER. Vincentio Reinieri, *d.* 1648. (R)

A Genoese monk, pupil and friend of Galileo. He was professor of mathematics in Pisa, and published astronomical tables. While working at his tables of Jupiter's satellites, in Florence, he died suddenly. The Inquisition sought to destroy his writings, and apparently was partly successful. Riccioli placed him near Galileo in the Oceanus Procellarum. **524 K e**

REINHOLD. Erasmus Reinhold, 1511–1553. (R)

Professor of mathematics in Wittenberg University with Rhaeticus, his colleague and friend. These two were at first the only defenders of the views of Copernicus. Reinhold's *Prussian Tables,* published at the expense of Duke Albert of Prussia, were based on Copernican principles, and were found superior to the Alphonsine: they gradually became popular, till superseded by Kepler's *Rudolphine Tables.* Reinhold died of the plague. **525 G e**

REPSOLD. Johann Georg Repsold, 1771–1830. (M)

Born at Wremen, in Hanover. He founded the well-known mechanical-optical business in Hamburg, and from 1802 his astronomical instruments were famous, especially the fine division of his meridian circles. The work was continued by his family to the third generation, and throughout the nineteenth century the firm furnished first-class instruments to observatories. He was accidentally killed by the fall of a wall during a fire in Hamburg. **526 HJ b**

RHAETICUS. Georg Joachim Rhaeticus, 1514–1576. (M)

Born in Rhaetia, hence his Latin surname. He studied astronomy at Nüremberg, and was professor of mathematics at Wittenberg. He went to visit Copernicus at Frauenburg, and stayed two years, enthusiastically accepted his views, and wrote the first easily accessible account of them, the *Prima Narratio* (1540). Finally he received the much-desired permission from Copernicus to print his book. His own trigonometrical tables, constructed just before his death in Hungary, are the basis of those still in use: they were extended by Vieta and Pitiscus. **527 E ef**

RHEITA. Anton Maria Schyrle of Rheita, 1597–1660. (R)

A Capuchin friar, a clever optician, who constructed a "Kepler telescope" of two convex lenses, and encouraged its use. In his book on optics, with the curious name *Oculus Enoch et Eliae, seu Radius Sidereo-mysticus* (1645), he gives useful instructions for cutting and polishing glass, and describes his invention of the terrestrial eyepiece. The book contains a map of the Moon, drawn by himself.

Rheita was not his name, but his birthplace in Bohemia. He died in Ravenna. **528 C hj**

RICCIOLI. Joannes Baptista Riccioli, 1598–1671. (R)

Jesuit professor of philosophy, theology, and astronomy in Bologna. His *Almagestum Novum* is a comprehensive work on astronomy, theoretical and practical, historical and contemporary, illustrated by many diagrams and a map of the Moon initiating the system of nomenclature still in use, which differs from those of Langrenus and Hevelius. He corresponded with many astronomers, and was an ardent opponent of the Copernican and supporter of the Tychonic system. Over 200 of his lunar names are still in use. **529 K f**

RICCIUS. Matteo Ricci, 1552–1610. (R)

Jesuit missionary to China. Born in Macerata (Italy), he prepared for his mission chiefly in Rome, where he studied mathematics under Clavius. In Macao (Portuguese China) he taught his disciples Western science, especially mathematics and astronomy, and with their help translated Euclid into Chinese, "the westerner orally translating, Hsü Kuang-Ch'i recording with his brush." He also wrote original text-books for them, and remained with them until his death, when he was buried with great honour. **530 D hj**

RIPHAEUS, Mts. More correctly Rhipaeus. (M)

Mountains of early Greek geographers, from which the north wind blew. Hevelius gave this name to a northern lunar range, but Mädler's is just south of the lunar equator. **531 H f**

RITCHEY. George Willis Ritchey, 1864– . (Kr)

He made his first telescope while at college in Cincinnati, and Hale invited him when twenty-four years old to join the staff of Yerkes Observatory. There he took fine photographs of the Moon, and discovered the expanding nebulosity round Nova Persei. He was head of the optical shop of Mt Wilson Observatory, figured the 60-in. and 100-in. mirrors there, and photographed spiral nebulæ. He visited France, 1923–1931, and made the first large cellular mirror (60 in.). Returning to America, he built the 40-in. Ritchey-Chrétien telescope, and was made director of photographic and telescopic research at the Naval Observatory. **532 E f**

RITTER. Karl Ritter, 1779–1859. (M)

German geographer, born at Quedlinberg. He was tutor in a private family, in Frankfurt and Göttingen, and afterwards professor of history in Berlin, but he found time also to travel extensively. His *Erdkunde* treated geography in an original way, regarding it in relation to natural history and human progress. **533 D e**

ROBINSON. John Thomas Romney Robinson, 1792–1882. (B)

Irish astronomer and physicist, inventor of the cup anemometer. Born in Dublin, he studied at Trinity College there, and was for some

years deputy professor of natural philosophy. In 1823 he was appointed to the Armagh Observatory, and remained there for the rest of his life. He published the *Armagh Star Catalogue* of over 5000 stars, and many papers in scientific journals. **534 G a**

ROCCA. Giovanni Antonio Rocca, 1607–1656. (R)

Italian mathematician, born and died at Reggio. He did not publish any books, but corresponded with Cavalieri and Torricelli, by whom he was highly esteemed for his mathematical attainments. He is called Anton Rocca in Riccioli's list of lunar names. **535 K g**

ROEMER. Ole Roemer, 1644–1710. (Schr)

Famous for his discovery, in 1675, of the velocity of light, through observation of the times of eclipse of Jupiter's satellites. He was a Danish astronomer, born at Aarhus, and after nine years in Paris Observatory at Picard's invitation was appointed professor and Director of the Observatory in Copenhagen. He devised and constructed many fine instruments, including the first transit-instrument to be made, about 1690. **536 C c**

N.L.F. gives Riccioli as authority, in error.

ROOK, Mts. Lawrence Rooke, 1622–1666. (Schr)

Professor of astronomy at Gresham College, London, and one of the original members of the Royal Society. He made a special study of Jupiter's satellites, observing them up to the night of his death, and he was one of the first to record accurately their immersions and emersions. **K g**

The mountainous Rook Islands off New Guinea have been suggested, but Schröter almost always called his mountains after astronomers or mathematicians; and he named many Englishmen.

RORIS, Sinus. Bay of Dew. (R) **H b**

ROSENBERGER. Otto August Rosenberger, 1800–1890. (M)

Born at Tukkum, in Courland. He was assistant at Königsberg Observatory under Bessel, and afterwards professor of mathematics and astronomy at the University of Halle. His name is chiefly remembered for his remarkably accurate prediction of the return of Halley's comet in 1835, for which he was awarded the Gold Medal of the R.A.S. **539 D k**

ROSS. Sir James Clark Ross, 1800–1862. (M)

In an expedition under his uncle, Sir John Ross, he determined the position of the north magnetic pole (1831); then worked on the Magnetic Survey of Great Britain; and in response to Humboldt's suggestion, in 1836, of international co-operation in magnetic research, he was sent out to the Antarctic. He located the south magnetic pole, discovered the Great Ice Barrier and the volcanic mountains named after his ships *Erebus* and *Terror*, and reached a latitude of −78°. The Ross Sea is named after him. **540 D de**

ROSSE.   William Parsons, Earl of Rosse, 1800–1867.   (N)

In his observatory at Parsonstown, Ireland, he experimented in casting and polishing specula, and achieved a notable success with his famous six-foot telescope.   With this he discovered much fine detail and some new features in nebulæ, the most important being the spiral form.   He named several, such as the Owl, Crab, and Dumb-bell. **541 C g**

ROST.   Leonhardt Rost, 1688–1727.   (Schr)

An amateur astronomer of Nüremberg, who observed with Wurzelbauer.   He published a deservedly well-known *Astronomisches Handbuch,* an *Atlas Portabilis Coelestis,* and a description of a solar and a lunar eclipse of 1724 seen in Nüremberg.   He observed sunspots, and explained them as caused by vapours rising from volcanoes which tear open the bright outer covering of the Sun and expose a dark surface below.   **542 G k**

ROTHMANN.   Christopher Rothmann, died *c.* 1600.   (Smt)

An able mathematician and theoretical astronomer, assistant from 1577 to Wilhelm of Hesse in his observatory at Cassel, and invented several methods of dealing with astronomical problems.   He was a convinced believer in Copernicus, and discussed the subject in correspondence with Tycho, defending his views with ability.   In 1590 he spent a month with Tycho at Hveen, then went home to Bernburg, in Anhalt, and never returned to Cassel.   He must have died some time between 1599 and 1608.   Very little is known of his life.   **543 CD h**

RÜMKER.   Karl Ludwig Christian Rümker, 1788–1862.   (Lee)

German astronomer, director of the Hamburg School of Navigation, and then in succession director of the Observatories of Parramatta (Australia), Hamburg, and Lisbon, where he died.   He published a *Manual of Navigation,* and catalogues of northern and southern stars; and at Parramatta he discovered and observed Encke's comet at its return in 1822, when it was invisible in the northern hemisphere. **544 J b**

The name is erroneously attributed to Schmidt in *N.L.F.*

RUTHERFURD.   Lewis Morris Rutherfurd, 1816–1892.   (Gaud)

Abandoning his profession of barrister, he added observatory and workshop to his house in New York, and devoted himself to astronomy. His work on stellar spectra began simultaneously with that of Huggins and Secchi; and with the first lens devised and made for celestial photography he produced the finest lunar photographs then seen. His solar photographs also showed fine detail, and with those of star clusters he demonstrated the advantages of measuring by photography. His ruled gratings for solar spectra were the best until surpassed by those of Rowland.   **545 F k**

SABINE.   Sir Edward Sabine, 1788–1883.   (M)

Astronomer to the Arctic expeditions of Ross and Parry in 1818 and 1819.   Later he travelled to Spitzbergen and tropical Africa and America to determine the figure of the Earth by pendulum experiments.   He also studied magnetism, and announced to the Royal Society in May 1852 his discovery of the connection between magnetic storms and the sunspot cycle (discovered independently and announced later in the same year by Wolf and Gautier).   He was born in Dublin. **546 D e**

SACROBOSCO.   John Holywood, *d.* 1256.   (R)

A Yorkshireman, universally known by his Latinized name, who studied in Oxford and then settled in Paris as a teacher of mathematics. His *Sphaera Mundi*, based on Alfraganus and Ptolemy, describes the apparent movements of stars and planets, sun and moon, and explains them shortly and simply on Ptolemy's system.   It was a favourite text-book, taught in all the schools, for more than 300 years, and was translated from the original Latin into English, French, German, Italian, Spanish, and Hebrew.   **547 D gh**

SANTBECH.   Daniel Santbech Noviomagus, fl. 1561.   (R)

Dutch mathematician and astronomer, born at Nijmegen (hence his Latin surname).   He is chiefly known for his work in publishing the great treatise of Regiomontanus, *De Triangulis planis et sphaericis*, which marked the birth of trigonometry in Europe, together with sine tables of his own (Basle, 1561).   Riccioli also praises the *Problemata Astronomicorum et Geometricorum* of Santbech, which deals among other things with observations of Sun, Moon, and stars, and is illustrated by beautiful woodcuts, including figures of the zodiacal constellations.   **548 B g**

SASSERIDES.   Gellio Sasceride, 1562–1612.   (R)

Born in Copenhagen, where his father was professor of Hebrew, he went to Uraniborg as pupil and assistant to Tycho, 1582–1588. Going abroad to continue his studies, he took copies of Tycho's book on the comet of 1577 to Rothmann at Cassel and Möstlin at Tübingen, and sent one to Magini at Bologna when he had reached Padua. There he matriculated, and observed Mars with Magini during the favourable opposition of 1591 to which Tycho had called their attention.   At Basle he took the degree of doctor of medicine, then returned to Denmark, married, and became professor of medicine in Copenhagen.   **549 F j**

The correct Latin form of his name, used by himself, is Gellius Sasscrides.

SAUNDER.   Samuel Arthur Saunder, 1852–1912.   (Mül)

Mathematical master at Wellington College for thirty years.   He was keenly interested in all branches of astronomy, and devoted himself especially to selenography, where precise measures were

greatly needed. Having determined his fundamental points at the telescope, he catalogued over 3000 positions with an accuracy far greater than any attained before his time. He also caused steps to be taken to secure a standard authoritative system of lunar nomenclature, and four sections of the *N.L.F.* Map are based on his measures. His presidential addresses to the B.A.A. in 1903 and 1904 deal with the history and prospects of selenography. **550 E f**

SAUSSURE. Horace Benedict de Saussure, 1740–1799. (M)

Born at Geneva, and was professor of philosophy in Geneva Academy. He became a member of the French National Assembly in 1798. His great life interest was the exhaustive study of the Alps, their origin, geology, and chemical composition. He invented and improved many scientific instruments, including hygrometers and anemometers. His son Nicholas shared in these researches, and continued them after his father's death. **551 F j**

SCHEINER, Christopher Scheiner, 1575–1650. (R)

Born in Suabia, entered the Society of Jesus in 1595, taught Hebrew and mathematics at Ingolstadt, and was for some time professor of mathematics in Rome. He made the first prolonged and systematic study of sunspots, constructing a telescope and inventing the method of projection and the pantograph for this work. His *Rosa Ursina sive Sol* (1630), dedicated to the Duke of the Orsini, contains observations and drawings which cover the years 1611–1625, with determinations of the sun's equator and rotation period. **552 G k**

SCHIAPARELLI. Giovanni Virginio Schiaparelli, 1835–1910. (B)

Born at Savigliano, graduated at Turin, studied astronomy under Encke in Berlin, was assistant at Pulkovo, then at Brera, and succeeded Carlini as director there. He discovered the connection between the Perseid meteors and comet 1862 III, and between the Leonids and comet 1866 I; measured many double stars; studied the planets, announcing the *canali* on Mars in 1877, and their duplication two years later. He concluded that the periods of rotation and revolution are equal for Mercury and also for Venus. After his retirement he wrote on the astronomy of the Old Testament, and of ancient Greece and Babylon. **553 J d**

SCHICKARD. Wilhelm Schickard, 1592–1635. (R)

Born in Württemberg, and became professor of Hebrew and mathematics at Tübingen. His are the only observations of the comet of 1625 which have come down to us, recorded in Kepler's diary; and they are important from its probable identity with comet Pons-Coggia-Winnecke-Forbes. He made researches on the transit of Mercury in 1631, and was the first to attempt, in 1624, to estimate the path of a meteor from simultaneous observations made in different places. **554 H j**

SCHILLER.   Julius Schiller, fl. 1627.   (R)

An Augustinian monk of Augsburg, of whose life nothing is known.   His name survives as author of a Christian Star Atlas (*Coelum Stellatum Christianum*, Augsburg, 1627), based on Bayer's *Uranometria*, but with names and figures of the ancient constellations changed to represent Biblical characters and objects.   The twelve zodiacal constellations become the twelve apostles; the Great Bear, Peter's Boat; Ship Argo, Noah's Ark, and so on.   The change was not accepted, and the book is now very rare.   **555 GH jk**

SCHMIDT.   Johann Friedrich Julius Schmidt, 1825–1884.   (B)

After being assistant at Hamburg, Bilk, and Bonn Observatories, he became Director of Athens Observatory in 1858.   His six-foot lunar map, published in 1878, represents thirty-four years' work. He had excellent sight, skill and accuracy in drawing, and added some 2000 new features to those already mapped, including 300 rills, also measured many mountain heights.   In 1866 he reported the disappearance of the crater Linné, and discovered Nova Coronæ, in 1876 Nova Cygni;   and he observed and investigated comets, nebulæ, variable stars, meteors, and the meteorology of Greece. After retirement, he continued to observe with a small equatorial from his house in Athens. (*See* LOHRMANN, MOLTKE, SINAS.) **556 D e**

SCHNECKENBERG, Mt.   Spiral Hill.   (Kr)

It was described by Mädler as having this appearance—"fast die Gestalt eines Schneckenberges."   During the controversy about Hyginus N, which is near it, "Mädler's Schneckenberg" was often referred to, and thus the name came into general use, but Krieger was the first to print it on a chart.   **557 E e**

SCHOMBERGER.   Georg Schoenberger, 1597–1645.   (R)

Jesuit mathematician and astronomer, born at Innsbruck, became professor of mathematics at Freiburg-in-Breisgau, and died at Hradisch.   He wrote on the Sun and sunspots, which he called "stellae solares," believing (as Scheiner did at first) that they were satellites of the Sun.   Scheiner quotes in his *Rosa Ursina* some of Schoenberger's observations.   He wrote also on optics, and a work on sundials: *Demonstratio et Constructio Horologium novorum*.   **558 E k**

SCHRÖTER.   Johann Hieronymus Schröter, 1745–1816.   (Gru)

He had a private observatory at Liliental, near Bremen, containing reflectors by Herschel and Schrader, one of twenty inches aperture, with which he made regular observations of Moon and planets.   His lunar work, published in his *Selenotopographische Fragmente* (1791 and 1802), was the earliest contribution to the study of lunar details on an adequate scale, and he was the discoverer of the "clefts" or "rills."   He aimed specially at detecting changes, and

found notable instances in craters Alhazen and Linné. His observatory was destroyed during the campaign of 1813. **559 F e**

SCHUBERT.   Theodor Friedrich von Schubert, 1789–1865. (M)

Born in St Petersburg, entered the Russian Army, and rose to be General. He was head of various departments for military topography, astronomy, and triangulation; and in 1833 was appointed by the Tsar chief of the Chronometer Expedition to determine longitudes of Baltic ports, Schumacher, Argelander, Bessel, and Struve co-operating. He was member of the Academy of Science in St Petersburg, and wrote many scientific papers, including an essay on the figure of the Earth. After 1861 he lived in Italy or South Germany, and died in Stuttgart. **560 A e**

SCHUMACHER.   Heinrich Christian Schumacher, 1780–1850. (M)

Born in Holstein, then part of Denmark, and at school in Altona taught himself mathematics and astronomy, observing with instruments partly made by himself. He qualified for the law, but gave it up for astronomy, studied under Gauss, became Director of Mannheim Observatory, then professor of astronomy at Copenhagen. From 1817 he directed the survey of Holstein, moving for this work to the new observatory at Altona. There he published ephemerides and founded the important periodical *Astronomische Nachrichten,* of which he edited the first thirty-one volumes. **561 B b**

SCHWABE.   Heinrich Schwabe, 1789–1875. (Smt)

Born and died in Dessau. His great astronomical work was the discovery of the eleven-year cycle in sunspot activity. His solar work began in 1826, and when in 1857 he received the Gold Medal of the R.A.S., the address stated that "Twelve years he spent to satisfy himself, six more to satisfy and still thirteen more to convince mankind" of his discovery, and that "the energy of one man has revealed a phenomenon that had eluded the suspicion of astronomers for 200 years." **562 D a**

SCORESBY.   William Scoresby, 1789–1857. (M)

Born in Yorkshire, son of a famous whaler, made many expeditions with his father, took over command in 1811. In 1822 he explored the east coast of Greenland for 400 miles. Afterwards he entered the Church, but always maintained his interest in navigation and science: contributed sixty papers to the Royal Society, on terrestrial magnetism, improvements in the compass, meteorology, natural history survey of Greenland, heights of sea-waves, ocean temperatures. Scoresby Sound in Greenland commemorates the name. **563 E a**

SECCHI.   Angelo Secchi, 1818–1878. (B)

Born at Reggio; entered the Society of Jesus, 1833; was tutor of mathematics and physics in Rome, professor at Loreto, and for one year at Georgetown, U.S.A., then at the Collegio Romano till his death.

He was one of the great pioneers in stellar spectroscopy, classifying provisionally 4000 stars in four spectral types. He also investigated the movements and distribution of sunspots, proved the solar nature of prominences at the eclipse of 1860, kept daily records of chromosphere and prominences, and observed the flash spectrum in 1870. **564 B e**

SEELIGER. Hugo von Seeliger, 1849–1924. (Kr)

Born at Bielitz-Biala (then in Austria); studied at Heidelberg and Leipzig, was assistant to Argelander at Bonn Observatory, where he observed star positions for the *Astronomische Gesellschaft Catalogue*. From 1882 Director of Munich Observatory, which he made a great centre of astronomical training. He did pioneer work in the modern study of stellar distribution; confirmed by new methods the nature of Saturn's rings as discrete particles; investigated the motion of Mercury's perihelion, suggesting the mass of the zodiacal light as its cause. **565 E f**

SEGNER. Johann Andreas von Segner, 1704–1777. (Schr)

Born at Presburg, was professor of physics at Jena University and subsequently at Göttingen. He was a prolific and learned writer. His chief astronomical work appears to have been a discussion of the geometry of eclipses; he wrote on other branches of mathematics, notably on hydrodynamics, in which he was the first to discuss the surface tension of liquids (in a publication of the Royal Society of Göttingen, 1751). He wrote also on meteorology. **566 G k**

SELEUCUS. *c.* 150 B.C. (R)

A Babylonian who, according to Strabo, lived at Seleucia, on the Tigris, and studied the tides in the Erythraean Sea; he showed that they were caused by the Moon. He taught, like the Greek Aristarchus about a hundred years earlier, that Earth rotates on her axis and revolves round the Sun. **567 K d**

SENECA. Lucius Annaeus Seneca, 3 B.C.–A.D. 65. (R)

Roman statesman and orator, praetor under Agrippina and tutor to her son Nero, adviser and writer of State papers when Nero became Emperor. Finally he fell into disfavour and at Nero's command put an end to his own life. He wrote on ethics and philosophy, and a treatise on meteorology and astronomy (*Quaestiones Naturales*), where he discussed comets and concluded, in opposition to Aristotle, that they were heavenly bodies moving in fixed orbits, and that it would some day be possible to predict their return. **568 A c**

SERAO. Francesco Serao, 1825–1911. (Smt)

Italian journalist, born near Naples. He fought for his country in the Venetian and Lombard campaigns of 1848; then lived for ten years in Patras (Greece), where he held important posts in the English service, and his daughter, Matilde Serao, the novelist (1856–1927) was

born; he returned to Italy in 1860, and died in Naples. Schmidt gave the name in 1856 without explanation: as he was in Capodimonte (Naples) in 1855, and lived in Athens from 1859, he may have been a friend of the Serao family, and this identification seems the most probable. **569 F d**

SERENITATIS, Mare. Sea of Serenity. (R) **570 D c**

SHARP. Abraham Sharp, 1651–1742. (Hell)

Born near Little Horton, in Yorkshire. He opened a school in Liverpool, then held an appointment at Chatham Dockyard. He moved thence to Greenwich and was Flamsteed's faithful friend and skilful assistant: he calculated many tables for the *Historia Coelestis*, and graduated the seven-foot mural quadrant, Flamsteed's best instrument. On retiring, he returned to Little Horton, and built a small observatory, making his own instruments. **571 H b**

SHEEPSHANKS. Anne Sheepshanks, 1789–1876. (B)

Sister of Richard Sheepshanks, F.R.A.S., with whom she lived from the time he left college. After his death she gave to the R.A.S., according to his wish, all his astronomical and other scientific instruments, and endowed the Sheepshanks Exhibition at Cambridge in his memory. She also gave generous donations to Cambridge University for the advancement of astronomy and kindred sciences, and a new transit-instrument to Cambridge Observatory. She was made Honorary Member of the R.A.S. in 1862. **572 E a**

SHORT. James Short, 1710–1768. (Schr)

Scottish mathematician and optician, who perfected the concave speculum for reflecting telescopes by producing a true parabolic figure. His instruments were extremely popular, being free from both spherical and chromatic aberration, and much more convenient than the very long refractors used by Huygens, Hevelius, and others. He was also a diligent observer, particularly of Saturn, the Sun, and Venus. He was born in Edinburgh, entered the university there, and studied mathematics under Maclaurin. **573 F k**

SHUCKBURGH. Sir George Shuckburgh, 1751–1804. (Lee)

Of Shuckburgh Park, Warwickshire. Fellow of the Royal Society, and communicated several papers to *Philosophical Transactions*, chiefly on his observations and methods of measuring mountain heights by means of the barometer. His equatorial telescope, begun by Ramsden and finished in 1791, was presented to Greenwich Observatory by his heir in 1811, and is known as the Shuckburgh telescope. **574 C b**

SILBERSCHLAG. Johann Essaias Silberschlag, 1721–1791. (M)

Born at Aschersleben, he was for many years preacher in Magdeburg, afterwards pastor in Berlin, where he also filled some Government posts, including the directorship of a State school. When very little was yet known about meteors he calculated the track of one and

wrote a monograph upon it. It was seen in July 1762 by several observers at Zeitz and near Potsdam.   **575 D e**

SIMPELIUS (more correctly Sempilius). Hugh Sempill, 1596–
  1654. (R)

Member of a well-known Scottish family.   The 4th Lord Sempill was Scottish Ambassador to Spain, and his son, William, founded the Scots College of Jesuits in Madrid.   Hugh joined the Order in Toledo in 1615, and became Rector of the Madrid College, where he died. He was an accomplished linguist and mathematician, author of *De Mathematicis Disciplinis* (1635), which contains sections on astronomy, astrology, and the calendar, also other works, mathematical and theological.   **576 E k**

See Sherburne's *Sphere of Manilius* (London, 1675), p. 89, for Hugo Sempilius. Riccioli's spelling differs slightly, but as he adds "Soc. I." he evidently means the above, his contemporary and fellow-Jesuit.   In Langrenus' map the spelling is correct.

SINAS. Simon Sinas, 1810–1876. (Smt)

A generous patron of astronomy. He appointed Schmidt Director of Athens Observatory in 1858, and provided for his salary, the repair of instruments, and publication costs. His widow, Iphigenia Sinas, continued his benefactions. Simon was the son of Baron George Sinas, a successful and patriotic Greek merchant, Consul-General for Greece in Vienna, where he settled; he had built, equipped, and given to his country the Athens Observatory in 1846, and died 1856. **577 C e**

The name is incorrectly spelt without final "s" in *N.L.F.*

SIRSALIS. Gerolamo Sirsali (or Sersale), 1584–1654. (R)

Born, lived, and died in Naples, entered the Society of Jesus in 1607, taught philosophy and theology at the Jesuit College at Naples. He was a zealous amateur astronomer, and possessed a good telescope. Riccioli mentions him among the expert selenographers who followed Langrenus and Hevelius, and says he had drawn a map of the full Moon, though without naming the formations or appending any description.   Grimaldi's lunar map in Riccioli's *Almagestum Novum* was based partly on the work of Sirsalis, as appears from its title. **578 K g**

SMYTHII (Mare). William Henry Smyth, 1788–1865. (Lee)

An admiral in the British Navy, actively engaged in the Napoleonic wars, he afterwards (1817–1824) carried out a great scientific survey of the Mediterranean. He studied astronomy under Piazzi, and on retiring built an observatory in Bedford, where he wrote his *Cycle of Celestial Objects*, containing the *Bedford Catalogue* of double and multiple stars, clusters, and nebulæ observed by himself. Later on he moved, to be nearer his friend and fellow-astronomer, Dr Lee. **579 A f**

Name attributed to Mädler in *N.L.F.*, in error.

8

SNELLIUS.   Willibrord Snell, 1591–1626.   (R)

Born at Leyden, and became professor there, visited Tycho and Kepler: his "Hessian" star catalogue included the observations made by Tycho at Prague, and was the first in which a clock served to determine the R.A.   He devised and used the method of triangulation still employed, and from a measured arc of the meridian found a degree = 51,000 toises.   In 1620 he discovered the relation between the angles of incidence and refraction in light-rays.   **580 B h**

SÖMMERING.   Samuel Thomas Sömmering, 1755–1830.   (M)

A celebrated surgeon, born at Thorn, studied at Göttingen, and became professor of anatomy at Mainz.   He wrote on various branches of natural science; made improvements in the microscope; and was one of the first to invent and construct a successful telegraphic apparatus, in 1809, but it was too costly for general use. **581 F ef**

SOMNII, Palus.   Dream Marsh.   (R)   582 B d

SOMNIORUM, Lacus.   Lake of Dreams.   (R)   CD bc

SOSIGENES.   Fl. 46 B.C.   (R)

Greek astronomer of the school of Alexandria, who was entrusted by Julius Caesar with the reform of the calendar.   He made the year independent of the Moon, and invented leap year to bring the average length to $365\frac{1}{4}$ days.   Nothing further is known of him. **584 D e**

SOUTH.   James South, 1785–1867.   (B)

One of the founders of the R.A.S.   With John Herschel he remeasured and catalogued William Herschel's double stars, and confirmed in many cases their mutual revolution, hence their true binary character.   Later he measured over 400 double stars alone. His observations in 1822 of an instantaneous occultation by Mars of a star in Leo disproved the supposed existence of an extensive Martian atmosphere.   **585 H a**

SPALLANZANI.   Lazaro Spallanzani, 1729–1799.   (Smt)

Born in Modena, he was educated at the Jesuit College of Reggio and the University of Bologna, where his kinswoman, Laura Bassi, was professor of physics and inspired him with a love of science. He travelled much in the Mediterranean, and enriched the museum at Pavia, of which he was curator, with his collections.   His experimental work was chiefly in physiology, and his most important publication was *Dissertazioni di fisica animale e vegetale* (1780). **586 D j**

SPITZBERGEN.   (Blagg)

Aptly named from the pointed peaks, and resemblance in shape to the island of Spitzbergen.   **587 F c**

SPÖRER. Friedrich Wilhelm Gustav Spörer, 1822–1895. (Kr)

Son of a Berlin merchant, and studied at Berlin University, where he was influenced by Encke and Dove. From 1874–1894 was on the staff of the Astrophysical Observatory, Potsdam. For over thirty years he systematically studied sunspots: he confirmed Carrington's results, and discovered the variation in latitude of spot zones in the course of the spot cycle, and the over-lapping of each cycle by the next; also sought out old records and compared them with his own. **588 F f**

SPUMANS, Mare. Foaming Sea. (Frz) **589 A e**

STADIUS. Jan Stade, 1527–1579. (R)

Belgian mathematician and astronomer, born in the village of Loenhout, near Antwerp. A pupil of Gemma Frisius, he studied and lectured at Louvain, afterwards going to Savoy, where he was entitled Royal Mathematician of the King of Spain. Later, Henri III of France summoned him to teach mathematics at the Collège de France, in Paris, where he ended his life. He is best known by his planetary tables, called *Tabulae Bergenses* after Robert de Berg, Prince-Bishop of Liége, and his ephemerides for Antwerp of Sun, Moon, and planets, for the years 1554–1606: they were much used, sometimes for astrological purposes. **590 G e**

STEINHEIL. Karl August von Steinheil, 1801–1870. (M)

Physicist and astronomer, born at Rappoltsweiler, in Alsace. He was professor of mathematics and physics in Munich, and made successful experiments in the development of telegraphy, but is chiefly famous for producing the first telescope with a mirror silvered by Liebig's process. It had an aperture of four inches and magnifying power of 100, and gave a very good image. Von Steinheil also did pioneer research work in stellar photometry. **591 C j**

STEVINUS. Simon Stevin, 1548–1620. (R)

Born at Bruges, of poor parents, he was first bookkeeper and cashier at Antwerp, then clerk of the Treasury at Bruges, finally a professor in Holland, and friend of Prince Maurice of Nassau, who appointed him inspector of dykes and quartermaster-general. In his *Principles of Statics* (1586) he enunciated the theorem of the triangle of forces; and he established the use of decimal fractions. He was also known by his military methods and inventions; and by a carriage with sails, carrying twenty-six passengers, which was used on the seashore. He published treatises on arithmetic, geometry, optics, and cosmography. **592 B h**

STIBORIUS. Andreas Stoberl, 1465–1515. (R)

"Philosopher, theologian, and most acute astronomer," says Riccioli. He was born in Vilshofen, on the Danube, was professor of astronomy and mathematics in Vienna University, and president

of the learned society founded by the Emperor Maximilian, the Brotherhood of the Danube (Donaubruderschaft). Among his writings is the *Libellus de auctoribus mathematicis*, also an epitome of Ptolemy's *Almagest* and a *Book of Astronomical Instruments*. **593 C h**

STÖFLER. Johann Stöffler, 1452–1534. (R)

Born and died at Blaubauern, in Württemburg. He was professor of astronomy and mathematics in Tübingen, and won notoriety by his prophecy of a second Deluge to come on February 20, 1524, when Mars, Jupiter, and Saturn would be in conjunction. His work was chiefly concerned with ephemerides and almanacs; he also wrote on the construction and use of astrolabes, and a commentary on the *Sphere* of Proclus, and he made a celestial globe. **594 E j**

STRABO. *c.* 54 B.C.–*c.* A.D. 24. (M)

Greek geographer and historian, who lived for some years in Rome under Augustus, and travelled in many countries. His *History* is lost, but his *Geography* is preserved almost complete, and is the most important ancient work on that subject which we possess. It is based on Eratosthenes, but describes many interesting places much more fully, and deals especially with their history and customs. **595 D a**

STRAIGHT RANGE. (B)

Named from its appearance. **596 G b**

STRAIGHT WALL. (Elger)

Named from its appearance. **597 F gh**

STREET. Thomas Streete (or Street), fl. 1661. (Schr)

Author of *Astronomia Carolina: A New Theorie of the Celestial Motions . . . farre more Easie, Expedite, and Perspicuous than any before Extant. With exact and most Easie Tables thereunto.* It was published in 1661 and dedicated to Charles II, on the day of whose coronation Streete had observed a transit of Mercury with Mercator and Huygens at Long Acre, London. The book was translated into Latin (Nüremberg, 1705), and the tables were commended by Mercator. Streete's last work was *The Description and Use of the Planetary Systeme*, 1674. **598 F j**

STRUVE. Wilhelm Struve, 1793–1864. (M)

Born at Altona, studied at Dorpat University, and became director of the observatory there. When Tsar Nicholas established the new observatory at Pulkovo, Struve was appointed director, superintended its construction, and equipped it with the finest instruments obtainable. He was one of the first to succeed in finding a stellar parallax (that of Vega in 1840), and he carried out extensive geodetic operations; but he is chiefly famous as a great double-star observer. His *Mensurae Micrometricae* gives details of over 3000 double and multiple systems. **599 B b**

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STRUVE, OTTO. Otto Wilhelm von Struve, 1819–1905. (B)

Son of the former, his assistant and successor as Director of Pulkovo Observatory. He also was a double-star observer; discovered a satellite of Uranus; and investigated the parallax and motion of the Sun and the rings of Saturn. He retired to Karlsruhe in 1889. Of Otto's sons, Hermann was also a double-star observer, but known chiefly for his work on Saturn's satellites and the erection of Babelsberg Observatory in Berlin; and Ludwig was at Kharkov Observatory. Of Otto's grandchildren, Otto Struve is since 1921 director at Yerkes, and Emily Struve assistant at Pulkovo. **600 K d**

SUESS. Edward Suess, 1831–1914. (Kr)

Educated in Prague and Vienna, in 1857 professor of geology in Vienna, and in 1897 President of the Imperial Academy of Science. He was noted for special researches in the geology of Italy, the stratigraphy of the Alps, and the organization of brachiopod molluscs. His greatest work was *The Face of the Earth.* **601 J e**

SULPICIUS GALLUS. Fl. 168 B.C. (R)

Roman consul, orator, and scholar, who on the eve of the battle of Pydna, in Macedonia, 168 B.C., warned the Roman soldiers of an expected lunar eclipse and explained its nature, so that they remained calm when those in the opposite camp were terrified at the evil omen. Cicero describes him as so eager in his astronomical studies that he would sit up all night over his calculations, and felt old age no burden. **602 E d**

TACITUS. Cornelius Tacitus, *c.* A.D. 55–*c.* 120. (R)

Roman historian, an intimate friend of Pliny the Younger, and lived through many imperial reigns: he seems to have been appointed tribune by Vespasian, quaestor by Titus, and praetor by Domitian, and was probably at some time praetorian legate in Germany. His chief works are the *Life of Agricola* (his wife's father); *Germania,* describing the religion, customs, and institutions of the Germanic tribes; and the *Historiae* and *Annales,* parts of which only are now extant. **603 D g**

TANNERUS. Adam Tanner, 1572–1632. (R)

Jesuit mathematician and theologian, born at Innsbruck. He was professor of mathematics at Vienna and Ingolstadt, where his *Astrologia Sacra* was published in 1621; and he became chancellor of the University of Prague. He won fame as a confuter of heretics, and was patronized by the Emperor Ferdinand II. **604 D k**

TAQUET. André Tacquet, 1612–1660. (Schr)

Belgian mathematician, born at Antwerp. A prominent member of the Flemish school of Jesuits, he taught mathematics first at Louvain, then at Antwerp. His *Elementa Geometriae* was translated into English at Cambridge, but his treatise on astronomy and other manu-

scripts were published only after his death.   His work on the cycloids was praised by his friend, Christian Huygens, and paved the way to more extensive researches by Pascal.   **605 D d**

TARUNTIUS.   Lucius Taruntius Firmanus, fl. 86 B.C.   (R)

Roman mathematician, philosopher, and astrologer, born at Firmium, in Italy, hence his surname.   He is mentioned by Cicero and Plutarch, and was an intimate friend of Varro, "the most learned of the Romans."   It was said that at Varro's request he calculated on astrological principles the hour and day of Romulus' birth and of the foundation of Rome!   **606 B e**

TAURUS, Mts.   (Hev)   **BC cd**

TAYLOR.   Brook Taylor, 1685–1731.   (M)

One of the leaders of the English school of mathematics after Newton.   He published many papers, on the motion of projectiles, the centre of oscillation, and other subjects; but his chief work was the *Methodus incrementorum directa et inversa,* which contains the proof of "Taylor's Theorem" and ingenious applications of the calculus to various questions, including the vibration of strings.   From 1715 onwards he turned to philosophy and religion.   He died in London.   **608 D f**

TEMPEL.   Ernest Wilhelm Tempel, 1821–1889.   (Kr)

Born of poor parents at Nieder Kunnersdorf, he earned a living by lithography in various German towns; then went to Denmark and Italy, seeking adventure; married in Venice, and discovered his first comet (1859); went next to Marseilles, then to Brera Observatory, finally was director at Arcetri.   His love of beauty had attracted him to astronomy, and his artistic skill enabled him to make beautiful astronomical drawings, especially of nebulæ.   He discovered six asteroids and many comets, including "Tempel's Comet" of 1865–1866, associated with the Leonid meteors.   **609 DE e**

TENERIFFE, Mts.   (B)

See PIAZZI SMYTH.   **610 F b**

THALES.   Thales of Miletus, *c.* 624–*c.* 547 B.C.   (R)

The first of the Ionian philosophers, and founder of Greek geometry.   He taught that water is the first principle of all things, and Earth a disc surrounded by and floating on Ocean.   He was famed for predicting the eclipse which "turned day into night" and stopped a battle between Lydians and Medes, in 585 B.C.   He travelled much, especially in Egypt, and he advised the Greeks to steer, like the Phoenicians, by the Little Bear instead of the Great Bear.   **611 D a**

THEAETETUS.   *c.* 380 B.C.   (R)

A friend of Plato, who introduced him as one of the speakers in the Dialogues *Theaetetus* and *Sophistes,* representing him as a noble and well-disposed youth, ardent in the pursuit of knowledge, especially

of geometry. He was an Athenian, son of Euphronius of Sunium. He is near Plato in the Moon. **612 E bc**

THEBIT. Thebit ben Korra, 826–901. (R)

A Baghdad astronomer, of the school of Al Mamun. He translated Ptolemy's *Almagest*, and some works of Apollonius, Archimedes, and Euclid, into Arabic. To him belongs the doubtful honour of inventing the "trepidation" theory to explain the discrepancy between different estimates of precession, describing in his *Motion of the 8th Sphere* a mechanism which would cause the equinoctial points to oscillate back and forth. This notion haunted astronomy until finally exorcised by Tycho. (*See* ALMANON.) **613 F g**

THEON JUNIOR. Theon of Alexandria, *c.* A.D. 380. (R)

The last astronomer of the Alexandrian school, he wrote commentaries on Aratus and Ptolemy, but added nothing new to science. All that is known of his life is that he was father of the learned and beautiful but unfortunate Hypatia, and her teacher in mathematics and philosophy. **614 D f**

THEON SENIOR. Theon of Smyrna, *c.* A.D. 100. (R)

An arithmetician and astronomer living shortly before Ptolemy. He made observations of the Sun and planets, and his book on *Mathematical Subjects useful for the Study of Plato* contains a section on astronomy. This is founded on earlier Greek writings and teachings, and gives much valuable information, otherwise lost to us, about the history of Greek cosmology and astronomy. The other sections are on arithmetic and music. **615 D f**

THEOPHILUS. Saint Theophilus, *d.* 412. (R)

Bishop of Alexandria from 385. Riccioli includes him among the astronomers of Alexandria, probably on the strength of his Paschal Canon for determining the date of Easter, based on the nineteen-year Metonic cycle. He is chiefly remembered to-day as the convener of the Synod held in Constantinople in A.D. 403, which condemned St Chrysostom as a heretic. **616 C fg**

TIMAEUS. *c.* 400 B.C. (R)

A Pythagorean philosopher of Locri, in South Italy. Plato met him there after Socrates' death in 399 B.C.; they became friends, and he is represented in the Dialogue called by his name as an expert astronomer who explains to Socrates and others the origin and structure of the Universe and the movements of planets and stars. **617 E fa**

TIMOCHARIS. Fl. *c.* 280 B.C. (R)

Greek astronomer of the school of Alexandria. His measurement of the distance of Spica from the autumnal equinox enabled Hipparchus, about 150 years later, to demonstrate the precession of the equinoxes. **618 FG c**

TIMOLEON. *d.* 337 B.C. (Com)

Greek statesman and general, belonging to a noble family of Corinth. He was sent to defend the Greek colonies in Sicily from the Carthaginians; defeated them, concluded a treaty in 338, expelled tyrants from Syracuse and other cities, and restored democracy. He was then virtual ruler of Sicily, though living like a private citizen: the island flourished, and he was greatly honoured. **619 A c**

The name, given by Schmidt to another formation, is now revived.

TISSERAND. François Félix Tisserand, 1845–1896. (Kr)

Assistant astronomer in Paris Observatory from 1866; Director of Toulouse Observatory, 1873, and of Paris Observatory, 1892. He took part in expeditions for a total solar eclipse in 1868, and transits of Venus, 1874 and 1882; was member of the Académie des Sciences and Bureau des Longitudes, and professor of celestial mechanics at the Sorbonne. This was his special subject: he wrote numerous papers on lunar and planetary theories, and his great work was the *Traité de la Mécanique Céleste*, in four volumes. **620 B d**

TORRICELLI. Evangelista Torricelli, 1608–1647. (M)

As a youth he learned Greek and Latin under his uncle, but wishing to understand mathematics he studied this unaided until he was twenty, when he went to Rome and afterwards to Florence, met Galileo, and became professor there and a distinguished physicist. He discovered how to measure atmospheric pressure by means of mercury in a glass tube: hence the barometer was originally called a Torricellian Tube. **621 C f**

TRALLES. Johann Georg Tralles, 1763–1822. (M)

German physicist, born in Hamburg, studied in Göttingen, and became professor first in Berne, afterwards in Berlin. He invented the "Tralles alcoholometer," and wrote on his researches in the specific gravity of mixtures of alcohol and water (published, Leipzig, 1812). He died in London. **622 B c**

TRANQUILLITATIS, Mare. Tranquil Sea. (R) **623 BC ef**

TRIESNECKER. Franz de Paula Triesnecker, 1745–1817. (Lo)

Austrian mathematician and astronomer. Born in Kirchberg, near Krems, he entered the Order of Jesuits, studied and taught in Vienna; later studied theology in Graz and became doctor of philosophy. He was assistant and successor to Father Hell as Director of Vienna Observatory, where he made many measurements of Sun, Moon, and planets with the new Dollond heliometer, published tables, and reorganized the meteorology department. He also took part in survey work in Austria. He was member of learned societies in Göttingen, Prague, and St Petersburg. **624 E e**

TROUVELOT. Étienne Léopold Trouvelot, 1827–1895. (Fauth)

Born at Guyencourt; in 1851 emigrated to America, and there made many drawings of astronomical subjects, including the Moon, but especially of Jupiter and Saturn, which were published in *Harvard College Observatory Annals*. Returning to France in 1882, he joined Janssen at Meudon Observatory, and made a special study of solar prominences. He was one of the founders of the Société Astronomique de France. **625 E b**

TURNER. Herbert Hall Turner, 1861–1930. (Lam)

Born at Leeds, educated at Clifton College and Cambridge, chief assistant at Greenwich Observatory, later Savilian Professor at Oxford. He played an important part in the organization and work of the Astrographic Chart, and in the standardization of lunar nomenclature through the I.A.U.; in 1903 discovered Nova Geminorum; did valuable work on variable stars and seismology; and was extraordinarily generous in publishing or completing the work of others. While acting chairman at a seismological meeting in Stockholm he was suddenly taken ill, and died four days later. **626 G f**

TYCHO. Tycho Brahe, 1546–1601. (R)

Of the Danish nobility. He early developed a love for astronomy, and saw the need for systematic observation; travelled in Germany and met many learned men; discovered and wrote on the New Star of 1572; was given the island of Hveen by the King of Denmark for building his observatory, "Uraniborg"; with his pupils observed Sun, Moon, and planets, and made a star catalogue. After the king's death he went to Prague, was joined by Kepler, and there died. His world system differed from the Copernican, but his observations in Kepler's hands confirmed the latter, and made possible the discoveries of his successors. **627 F j**

UKERT. Friedrich August Ukert, 1780–1851. (M)

Historian and philologist. He was born in Eutin, became tutor in a private family in Danzig; then teacher in Weimar; then professor at a gymnasium in Gotha and librarian to the Duke and curator of his collection of coins. He wrote on ancient methods of measuring distances, and on the geography of Homer, Hecataeus, and the Romans. He died in Gotha. **628 E e**

ULUGH BEIGH. 1393–1449. (M)

Mongol prince, grandson of Tamerlane. He founded a school of astronomy and built a fine observatory with a forty-metre quadrant, near Samarkand, his capital. His most important work was a star catalogue based on new observations of most of Ptolemy's stars, with Azophi's magnitudes, and he also drew up planetary tables which were much used. He was assassinated by his eldest son, whose horoscope he had cast and found it so alarming that he made the

second his favourite; and after his death astronomy was no longer cultivated in Samarkand. (*See* AZOPHI.) **629 K c**

UNDARUM, Mare.   Sea of Waves. (Frz) **630 A e**

URAL Mts. (Kr-Kön) **631 H f**

VAPORUM, Mare.   Sea of Vapours. (R) **632 E d**

VASCO DA GAMA. 1469–1524. (M)

Famous navigator, descended from an ancient Portuguese family, and born in the little seaport town of Sines.   He was the first to sail to India via the Cape of Good Hope (1498), and was made Admiral of the Persian, Indian, and Arabian Seas: in this capacity he commanded twenty ships and defeated the Zamorin's fleet, his success leading to extensive Portuguese settlements in India.   He was made Viceroy of India, but died at Cochin three months after his arrival. **633 K d**

VEGA.   Georg, Freiherr von Vega, 1756–1802. (M)

German mathematician, famous for his tables of logarithms, which were based on those of Napier and Briggs, but served for more exact calculation.   He was also a historian of astronomy, and wrote on the determination of time, and on gravitation.   His body was found in the Danube, and he was thought to have been drowned by accident till, thirty years later, a miller confessed on his deathbed to the murder. **634 B j**

VENDILINUS.   Godefroid Wendelin, 1580–1667. (R)

Belgian astronomer.   Educated in Louvain, travelled in Europe, and was for eight years tutor and friend to a family in Provence, where he met Gassendi and Peiresc.   Later he settled as *curé* in his native village of Herck; finally was canon of Tournay Cathedral, and died in Ghent.   In science he was a zealous observer, but lacked knowledge and means to perfect and publish all his investigations.   He observed many lunar eclipses, asserted the variation in obliquity of the ecliptic, and determined a solar parallax of 14″. **635 A g**

VERIS, Mare.   Spring Sea. (Frz) **K g**

VIETA.   François Viète, 1540–1603. (R)

Born at Fontenay, near La Rochelle, studied law and practised for some time in Paris, but in 1580 was made master of requests, an office attached to the French Parliament, and spent the rest of his life in the public service, giving his leisure time to mathematics, in which he earned a great reputation.   He introduced the use of letters for both known and unknown quantities, applied algebra to geometry, and developed trigonometry, completing the system worked out by the Arabs. **637 J h**

VITELLO (or Witelo). Fl. 1270. (R)

The oldest manuscript form is Witelo; the Latin, Vitello or Vitellio, is later.   He styles himself Thuringopolus, and says he was

a Pole but came to live in Italy. He worked chiefly at Padua, later at Rome, and was influenced by Alhazen. A competent mathematician, and acquainted with classical and Arabian work, he wrote on perspective, refraction, the rainbow, and allied topics. Roger Bacon was in turn influenced by his work. **638 H h**

VITRUVIUS. Pollio Vitruvius, first century B.C. (R)

Roman architect and engineer under Augustus, to whom he dedicated his *De Architectura*. This was the chief authority on the subject throughout the classical revival, and is useful to the historian of science. He summarizes the work of earlier Greek and Roman writers, and incidentally treats also of hydrostatics and mechanics, physics and astronomy, especially methods of making sundials and water-clocks. **639 C d**

VLACQ. Adriaan Vlacq, died *c.* 1660. (M)

Bookseller and mathematician of Gouda, Holland. He published Napier's and Briggs' logarithmic tables, adding extensions from his own calculations. The final edition of this work, the *Arithmetica Logarithmica*, Gouda, 1628, contained tables of ten-figure logarithms which were more convenient than those of Vega; and it was often reprinted, at Amsterdam, Paris, Lyons, and elsewhere. He also published astronomical ephemerides for 1633–1636. According to a Dutch biographer he later settled in London. **640 D jk**

VOGEL. Hermann Karl Vogel, 1841–1907. (Kr)

Born in Leipzig, he studied there and in Dresden, where he became assistant at the Observatory and measured the positions of 232 nebulæ and clusters. In 1870 he was appointed director of von Bülow's observatory at Bothkamp, near Kiel; then went to Potsdam and was director there for twenty-five years. He advanced knowledge in nearly every branch of astrophysics, especially in spectral analysis, spectrophotometry, and radial velocities of stars. **641 E g**

WALLACE. Alfred Russel Wallace, 1823–1913. (Schr)

The celebrated naturalist who, independently and simultaneously with Darwin, propounded the theory of the origin of species by natural selection. He was born at Usk, in Monmouthshire, and from early youth studied botany, zoology, and geology. He travelled and collected on the Amazon, and in the Malay Archipelago, and here he discovered the sharply marked zoological boundary running between Celebes and Borneo which separates Australasia from Malaysia and is still called the "Wallace Line." **642 F d**

WALTER. Bernard Walther, 1430–1504. (R)

A wealthy citizen of Nüremberg, who provided Regiomontanus with astronomical instruments, became his pupil, and carried on his work when Regiomontanus died. He introduced new forms of

instruments and more accurate methods of observation; was the first astronomer to use clocks driven by weights; and his long series of solar, stellar, and planetary positions were of great value to Tycho. **643 EF h**

WARGENTIN.   Pehr Vilhelm Wargentin, 1717–1783.   (Schr)

A total eclipse of the Moon, seen when he was only twelve, inspired this Swedish boy to study astronomy; and he was Director of Stockholm Observatory when, in 1761, he saw another of special interest, the Moon being totally invisible for half an hour in a clear sky.   His work was very accurate, and his tables of Jupiter's satellites were much used by astronomers.   He received many honours in his own and other countries.   **644 H j**

WATT.   James Watt, 1736–1819.   (Smt)

Scottish engineer, inventor of the condensing steam-engine. Born in Greenock, he became mathematical instrument maker to Glasgow University, and made surveys for harbours and canals. He also invented a letter-copying press, an air-pump, and a smokeless furnace.   **645 C j**

WEBB.   Thomas William Webb, 1806–1885.   (N)

Vicar of Hardwicke and prebendary of Hereford Cathedral, well known as the author of *Celestial Objects for Common Telescopes*.   His astronomical observations, illustrated by drawings, were all distinguished by scrupulous accuracy, and he was always ready to help beginners.   His general assistance, and in particular his long and valuable series of lunar observations, are gratefully acknowledged by Neison in *The Moon*.   **646 A f**

The date of birth given by Espin (1807) is incorrect.

WEIGEL.   Erhard Weigel, 1625–1699.   (Schr)

Born near Weimar; after studying at Halle and Leipzig, became professor of mathematics and astronomy at Jena, where he died. He contributed materially to clearing up the calendar confusion in Germany, assisted by Leibniz, who was a student under him.   In his *Spherica* he proposed to replace the constellation figures by the coats of arms of various countries (Coelum Heraldicum): globes showing these figures exist at Cassel and elsewhere.   He improved various instruments, and published extensively on mathematics.   He had some reputation as an architect: his house was one of the seven wonders of Jena—Domus Weigeliana.   **647 G k**

WEINEK.   Ladislaus Weinek, 1848–1913.   (Fauth)

Born in Budapest, studied in Vienna and completed his astronomical training in Leipzig and Berlin.   He was on the staff in the observatories of Kiel, Leipzig, Strassburg; then from 1883 until his death professor of astronomy and director of the old observatory in

Prague. His *Mond-Atlas,* containing his enlargements of Lick and Paris photographs with drawings of fine details added, is well known to selenographers; but his finest lunar drawings are in the early numbers of the *Prague Observatory Publications.* **648 C h**

WEISS. Edmund Weiss, 1837–1917. (Kr)

Born in Freiwaldau, studied at the gymnasium in Opava, then at Vienna University, devoting himself specially to astronomy, mathematics, and physics; was assistant in Vienna Observatory, and in 1860 doctor of philosophy; then for some years occupied with geodesy. In 1875 he was appointed professor of astronomy, and founded, with Karl von Littrow, the present observatory of Vienna, succeeded him as director, and held the post for thirty years. He foretold the meteor shower of November 1872 after Biela's comet had failed to appear, and wrote on the connection of meteors and comets. **649 G h**

WERNER. Johann Werner, 1468–1528. (R)

Born in Nüremberg, educated in Italy, returned to his native town as pastor, and died there. He determined precession for different periods, notably from Spica, and made the supposed variation of the results the basis of an application of Thebit's trepidation theory, in which he was opposed by Copernicus; edited Ptolemy's *Geography*; proposed the use of lunar distances and occultations for longitude; observed the paths of comets; and contributed to the development of trigonometry. Riccioli placed him purposely near Regiomontanus, his predecessor in Nüremberg. **650 E h**

WHEWELL. William Whewell, 1794–1866. (B)

Cambridge philosopher and historian of science. Successively professor of mineralogy and moral philosophy, Master of Trinity College, and vice-chancellor of his university. One of the first members of the British Association, he drew up reports on tides and mathematical physics. Among his many books were the *Bridge-water Treatise, History of the Inductive Sciences, Philosophy of the Inductive Sciences*: his *Plurality of Worlds* was at first anonymous. **651 D e**

WICHMANN. Moritz Ludwig Georg Wichmann, 1821–1859. (N)

Born at Celle, near Hanover; became assistant to Bessel at Königsberg Observatory, later observer under Busch, on whose death he was acting as interim director when he fell ill himself. He worked on double stars, stellar parallax, and comets. With the Königsberg heliometer he determined the inclination of the lunar equator, and was one of the first to prove and measure the physical libration of the Moon, the existence of which (in addition to the well-known optical libration) had been demonstrated theoretically by Lagrange in 1786. **652 HJ f**

WILHELM I.   Wilhelm IV, Landgrave of Hesse, 1532–1592.   (R)

Gulielmus Hassiae Princeps (as Riccioli calls him) was the Land-grave Wilhelm IV the Wise, of Hesse, son of Philip I the Generous, during whose imprisonment he ruled: on his father's death the territory was divided and Wilhelm became the founder of the Hesse-Cassel branch.   Hence some confusion as to this name: Mädler, in preferring Wilhelm I, may have misunderstood "princeps"; but he may also have intended a compliment to his contemporary, Wilhelm IX, the Elector Wilhelm I.   Wilhelm IV established an observatory at Cassel, with Byrgius and Rothmann as his assistants; here he was visited by Tycho, with whom he had an extensive correspondence. He made many observations himself; and his application of time-differences to determine right ascensions, improved by Hagecius, was an important step towards meridian astronomy.   **653 G j**

WILKINS.   Hugh Percy Wilkins, 1896–   .   (Mül)

Born in Caermarthen, Wales, trained for the engineering pro-fession, and entered a foundry works in Llanelly.   From childhood a star-lover, he began observation with his own telescope at thirteen, and specialized on the Moon.   In 1924 he published a 60-inch lunar map; in 1932 a 200-inch; and his 300-inch is coming out in sections. His aim is to map the finest detail visible in his instruments, all made by himself, the largest being a twelve-inch reflector.   He has pub-lished many articles in the *English Mechanic*.   **654 D h**

WILLIAMS.   Arthur Stanley Williams, 1861–   .   (Kr)

Born at Brighton, studied law, and became a solicitor.   His observations of Jupiter, begun in 1879, have continued over more than fifty years: they were published in his *Zenographical Fragments* and many papers in *Monthly Notices*, notably one on *Surface Drifts on Jupiter*, which includes observations by Schröter and others.   He also worked at other planets and discovered several variable stars. In early years he made studies of the Moon, especially the interior of Plato and other selected regions.   The Jackson-Gwilt R.A.S. Medal was awarded to him in 1923.   **655 C b**

WILSON.   Alexander Wilson, 1714–1786.   (Schr)

Born at St Andrews, in Scotland, he studied in the university there, and in 1760 was appointed the first professor of practical astronomy in Glasgow.   He is remembered for his discovery, in 1769, that the changing appearance of a sunspot as it crosses the Sun's disc proves it to be a depression, although the depth is less than he imagined.   He was a friend of William Herschel.   **656 G k**

WÖHLER.   Friedrich Wöhler, 1800–1882.   (Smt)

Distinguished German chemist, born near Frankfort-on-Main; isolated aluminium by the method developed by Deville; discovered beryllium and yttrium.   His most important work was the synthesis

of the first organic compound prepared in the laboratory; he later worked with Liebig on the organic acids and was for forty-six years professor of chemistry at Göttingen. **657 C j**

WOLFF (Mt.).   Christian, Freiherr von Wolff, 1679–1754.   (Schr)

Renowned German philosopher.   Studied theology, mathematics, and philosophy in Jena, became professor of mathematics in Halle. His philosophical teachings were impugned, and in 1723 he was deprived of office and exiled, but was received by the Landgrave Karl of Hesse-Cassel and installed as professor in Marburg University. In 1740 his name was completely cleared, he was recalled to Halle, made Geheimrath and vice-chancellor of the University, and ennobled. The name Wolff also occurs in the eighteenth century as that of a professor of mathematics in Wittenberg, an observer with Heinsius in St Petersburg, the builder of an observatory in Danzig; but these were less well known than the above. **658 F d**

Hell gave this name in 1756 to the whole mountain range, but Schröter restored Hevelius' name of Apennine Mountains to this, and restricted Wolff (with double f) to the peaks in it called Q and R. *N.L.F.* retains Schröter's arrangement, but with Mädler's erroneous spelling, Wolf (one f).

WOLF, MAX.   Max Wolf, 1863–1932.   (Kr)

Born and lived in Heidelberg.   His father, a practising physician, encouraged his love of astronomy, and built a small observatory in the garden.   In 1884 "Wolf's Comet" was discovered.   As Director of Königstuhl Observatory he devoted himself to the novel art of celestial photography, and was the first to develop a photographic method of discovering asteroids; he and his assistants found more than 300. He also discovered thousands of nebulæ, and noted the connection of dark starless regions with galactic nebulæ; and he photographed spectra of nebulæ, comets, and Wolf-Rayet stars. **659 G g**

WOLLASTON.   William Hyde Wollaston, 1766–1828.   (M)

Born at East Dereham.   He studied medicine at Cambridge, then turned to chemistry; he discovered palladium (named from Pallas the planet, found the same year) and rhodium, and devised means to make platinum malleable.   He invented the camera lucida and the goniometer, and discovered the Fraunhofer lines in 1802, but took them for merely the boundaries of colours.   (*See* FRAUNHOFER.)   His astronomical work included a catalogue of double stars. **660 J c**

WROTTESLEY.   John, Baron Wrottesley, 1798–1867.   (B)

Amateur astronomer, original Fellow, President, and medallist of the R.A.S., later President of the Royal Society.   Established his private observatory first at Blackheath, producing a catalogue of 1373 stars, then at Wrottesley Hall.   Here he studied the relative parallax of optical doubles, publishing papers on the reduction of observations, a catalogue of 398 double stars, and a second meridan catalogue of

1009 B.A. stars. He was a member of the British Association Lunar Committee. **661 B h**

WURZELBAUER. Johann Philipp Wurzelbauer (or Wurzelbau), 1651–1725. (Schr)

A native of Nüremberg, he entered on a commercial career there, but studied astronomy under Eimmart and retired from business to devote himself to observation. Like Eimmart, he observed the Sun systematically. His publications on eclipses of the Moon attracted attention and he corresponded with all the leading academies and astronomers of the day. He was the first to notice the illusory bright spot on Mercury during transit. **662 G h**

XENOPHANES. Xenophanes of Colophon, *c.* 570–*c.* 478 B.C. (R)

Ionian philosopher, satirist, and poet; a religious and social reformer, representative of reaction from anthropomorphism to pantheism. His astronomy is obscure, probably comprising flat earth, infinitely thick, a new sun each day, moving in an infinite straight line (many thus coexisting), heavenly bodies made of clouds of fire, except the Moon, which is formed of dense cloud, and, unlike the Sun, is useless to living beings! **663 G a**

YERKES. Charles T. Yerkes, 1837–1905. (Kr)

Wealthy business man of Chicago, financier and traction magnate. In 1892, at Hale's suggestion, he gave two forty-two-inch glass discs (crown and flint), made by Mantois of Paris, to Chicago University for making the largest refractor in the world, and also provided funds for making and mounting it, and for building and equipping a suitable observatory to house it. The Yerkes Observatory was opened in 1897. **664 B d**

YOUNG. Thomas Young, 1773–1829. (Smt)

British physicist, born at Milverton, of a Quaker family. A precocious linguist, he was in later life a pioneer of hieroglyphic studies. He turned to science and medicine, and held important medical posts; at various times he was professor of natural philosophy at the Royal Institution, foreign secretary to the Royal Society, and superintendent of the *Nautical Almanac*. His fame rests, however, on his optical work, especially on the discovery of interference. **665 C j**

ZACH. Franz Xavier, Freiherr von Zach, 1754–1832. (M)

Born and educated in Hungary; served in the Austrian Survey; after a residence in London became Director of the Seeberg Observatory at Gotha, which he made the astronomical centre of Europe, editing the *Monatliche Correspondenz* and other publications for twenty-eight years. He took a leading part in Schröter's "astronomical police" to find the missing planet in the Titius-Bode series, and in the study of the first four asteroids; also published tables of

Sun and Moon and of aberration and nutation. Of many other activities, his numerous determinations of positions on the Earth, during official voyages, are notable. **666 E k**

ZAGUT. Abraham ben Samuel Zaguth (or Zacuto), late fifteenth century. (R)

A Spanish Jew, professor of astronomy in Carthage, and later in Salamanca, known as a leading authority on the calendar. His *Almanach Perpetuum*, dedicated to the Bishop of Salamanca and printed at Venice in 1472 and 1502, was edited by Gauricus and carried by Magellan on his great voyage. His observations of stars were quoted by Italian astronomers, and Riccioli says he was "astronomiae consultissimus." Becoming involved in controversy, he went to Lisbon and was appointed astrologer to the Portuguese Court. **667 D h**

ZENO. *c.* 340–*c* 264 B.C. (Smt)

Most probably Zeno of Citium, in Cyprus, founder of the Stoic school, to whom are attributed correct views as to the cause of eclipses, the reflection of sunlight by the Moon, and possibly the origin of her markings by variations of reflecting power: he regarded the Moon as a mixture of fire, earth, and air. **668 B b**

Schmidt gives no indication who is intended: so possibly he meant Zeno of Elea, *c.* 490–420 B.C., philosopher of the Eleatic school, associate of Parmenides, whose paradoxes of motion, including "Achilles and the Tortoise," anticipated Weierstrass; or Zeno of Prague, Jesuit astronomer, died 1781, who regarded comets as due to stellar collisions.

ZÖLLNER. Johann Karl Freidrich Zöllner, 1834–1882. (Smt)

Born in Berlin, and for many years lecturer and professor of physical astronomy in Leipzig. Inventor of the polarizing photometer, he determined, among many photometric researches, the albedoes of Moon and planets and the phase variations of the brightness of the Moon and Mercury. The electrical theory of comets proved fruitful; he invented the reversion spectroscope; and along with much philosophical work he also put forward a theory of the Sun's constitution. **669 D f**

ZUCCHIUS. Niccolo Zucchi, 1586–1670. (R)

Born at Parma, he became a Jesuit, chaplain to Pope Alexander VII, and professor of mathematics in the Collegio Romano. He proposed as early as 1616 the use of a concave mirror in place of the telescope objective, and actually examined the image with a concave lens but did not complete a practicable reflector (*cf.* MERSENNE). He was one of the first observers of Jupiter's belts, in Rome in May 1930. He also observed the Moon and Mars with telescopes of de Divinis and Campani. His *Optica Philosophica* was published in Leiden in 1652. **670 G k**

N.L.F. spells the name with one c, but Riccioli has two, and this is more correct.

ZUPUS: Giovanni Battista Zupi, *c.* 1590–*c.* 1650.   (R)

Italian Jesuit, long resident in Naples; a friend of Fontana, and observed with him.   Riccioli believed that Zupus was the first to see Jupiter's belts, and as he also states that Zucchius saw them in May 1630, Zupus' discovery must have been in or before that year.   He was probably the first also to see the phases of Mercury clearly, in 1639: they had been suspected by Marius, Hortensius, and Galileo. **671 J g**

1. *Riccioli's Map of the Moon, Bologna,* 1651 (*see pp.* 3, 4, *and* 6)
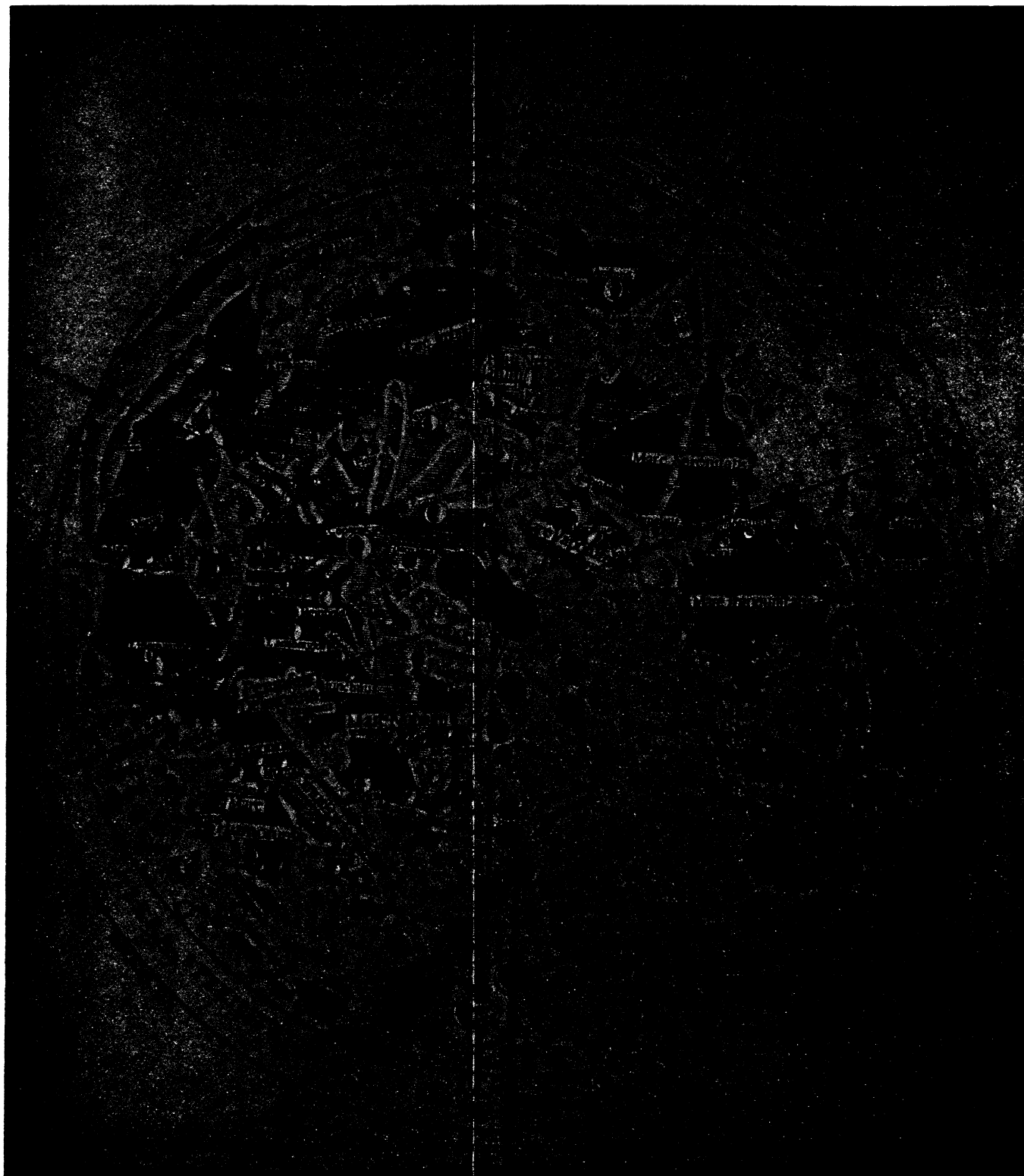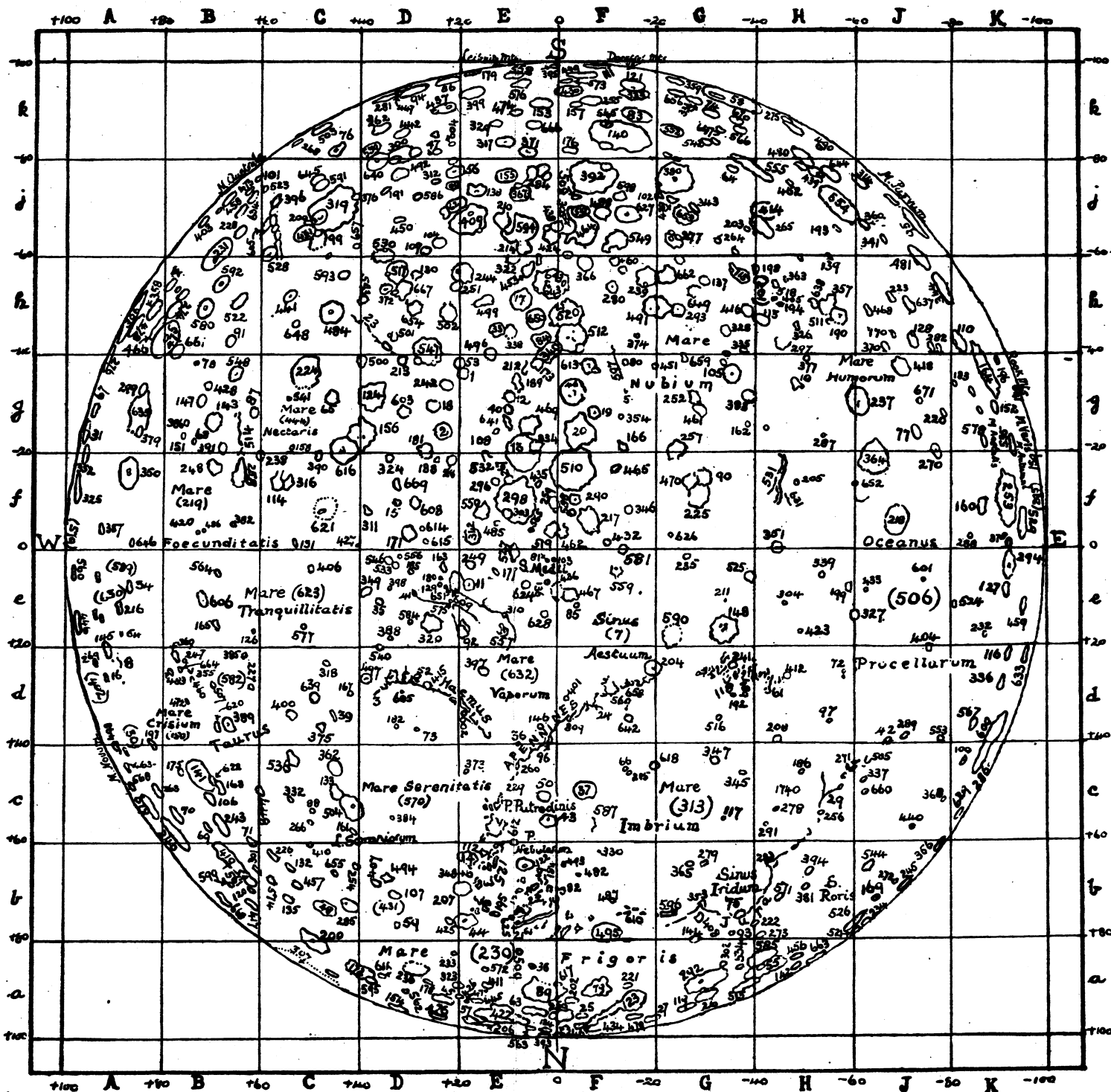
2. *Key-map of Lunar Formations, by G. E. Patston,* 1938 (*see pp.* 6, 7)