

his other continental correspondents. There are none to Agassiz, with whom he was in correspondence. It is to be hoped that in another edition some of these omissions may be supplied. They afford the best keys to the history of scientific opinions in the vigorous years of this century that have yet been given to us. Unfortunately, the most instructive part of his intercourse, that with his companions in his own society, did not, of course, find this form of expression; but there is enough in these two volumes to show the peculiar charm of his character and to explain his wide influence. It has been the good fortune of the writer to use the Principles for nearly twenty years as a 'compend' for lectures to a class of university students. The beauty of their spirit has served to enchain near a thousand students in the study of the science, while the recollection of instructive days with their author has freshened the labor of teaching. His was a pure, strong spirit, well pictured in his own charming account of the spirit of man, as free:—

“ire per omnes

Terrasque tractusque maris coelumque profundum.”

ASTRONOMICAL LITERATURE.

Bibliographie générale de l'astronomie, ou Catalogue méthodique des ouvrages, des mémoires et des observations astronomiques, publiés depuis l'origine de l'imprimerie jusqu'en 1880. Par J. C. HOUZEAU et A. LANCASTER. Tome Second: *Mémoires et notices insérés dans les collections académiques et les revues.* 1er fascicule, déc., 1880; 2e fasc., mars, 1881; 3e fasc., juin, 1881; 4e fasc., avril, 1882. Introduction, (?), 1882 [the whole volume consisting of 2,225 col., or about 1,100 p.]. 1. 8°.

BEFORE the publication of this work, there were three general scientific bibliographies of importance to astronomers,—Reuss' Repertorium, the Royal society's Catalogue of scientific papers, and Poggendorff's Handwörterbuch. The first two related only to memoirs, and not to separate books: the third included the most important books and memoirs of each author. Reuss (vol. v., Astronomy) was very far from complete to 1800; the Royal society's catalogue omitted whole series of journals from its plan, so that the work of MM. Houzeau and Lancaster has over forty per cent more entries for the corresponding period. Poggendorff's excellent work will always be useful. Of special astronomical bibliographies there are several; the two most important being Lalande's and the Catalogus librorum of the Pulkova observatory. These will always have a peculiar value; but for

practical purposes these and almost all other special bibliographies will be superseded as soon as M. Houzeau's work is completed.

Vol. ii. (the only one yet published) consists of references to all memoirs, etc., in the transactions of learned societies and in journals. These are classified by subjects,—somewhat minutely, as may be seen by the following extract, which contains all the divisions of celestial mechanics:—

SECTION V. — Mécanique céleste.

Sect.	Page.
1. L'attraction en général, sa cause; le mouvement d'un corps sous son influence . . .	527
2. Théorie générale des perturbations . . .	539
3. Perturbations principales des grandes planètes	564
4. Théorie des satellites	569
5. Variations séculaires des orbites des planètes	572
6. Masses des planètes	578
7. Stabilité du système planétaire	579
8. Théorie de la lune	582
9. Attraction des sphéroïdes	599
10. Rotation et figure des planètes et de leurs atmosphères	608
11. Théorie de la précession et de la nutation . . .	622
12. Théorie de la libration de la lune	625
13. Théorie des marées	626
14. La marée et le rotation du globe	634

The authors have added to very many of the references a brief note of the contents of the paper. These notes will often appear too brief and inexact to the specialist in each department (who will, however, be grateful for them when he is looking up some unfamiliar subject), and it would not be hard to find some misconceptions recorded in them; but they double the value of the book to the working astronomer, and are priceless to the pupil.

The best indication of the way in which the work is done is to be had by quoting one or two extracts at random:—

“BAILY (F.): On a remarkable phenomenon that occurs in total and annular eclipses of the sun. Londres, MAS., X, 1838, 1. [etc.] Les grains blancs, le peigne et la goutte noire.”

“WURM: Merkur. Ba J, Sup, II, 1795, 4. Diam. apparent.”

“SECCHI, A. Saturne, Le soleil, [etc.] p. 395, avec 1 dessin, p. 255.”

It may be noted here, that there are only some score of drawings of Saturn referred to: the list might be trebled easily. The registers of authors, etc., are most full and valuable; and every aid is provided for a quick consultation of the authorities.

It has been considered necessary to limit the scope of the work to astronomy proper, and sometimes this limitation is quite inconvenient. For example: measures or computations of the compression of the earth deter-

mined by geodetic methods have been excluded (and also measures of arcs of the meridian, length of seconds-pendulum, etc.), while only those determinations which are astronomical in their essence are given.

In some cases this produces strange lacks, yet it is probable that no better plan could have been chosen. Even in bibliography it is necessary to stop somewhere.

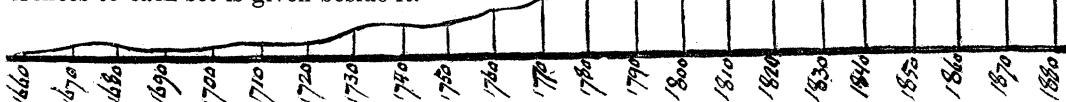
The introduction, of eighty-nine pages, is the most generally interesting portion of the work, as the statistics of astronomical bibliography (only of memoirs, etc., not books, be it remembered) are here discussed.

Some thirty thousand original articles are referred to in this volume. Leaving out the unimportant ones, the rest are divided as to language as follows:—

French	5,991	Dutch	85
English	5,809	Danish	39
German	4,438	Spanish	29
Italian	791	Portuguese	29
Latin	547	Polish	7
Swedish	118	Bohemian	6
Russian	89	Hungarian	6

Latin clearly is of secondary importance only, so far as works published in journals, etc., are concerned. French and English are of capital importance; German follows hard upon; Spanish and Polish are of the least scientific value, especially if one takes into account the populations using the various tongues.

The most valuable collections for an astronomical library are, in general, those containing the most references. The number of references to each set is given beside it.



CURVE OF FREQUENCY OF ASTRONOMICAL PUBLICATIONS, A.D. 1660-1880.

Monthly notices of the royal astronomical society (40 vol.)	1,573
Comptes-rendus de l'académie des sciences de Paris (93 vol.)	1,481
Histoire de l'académie des sciences de Paris (107 vol.)	779
Philosophical transactions of the royal society of London (169 vol.)	551
Memoirs of the royal astronomical society (45 vol.)	309
Proceedings of the royal society of London (28 vol.)	222
Reports of the British association for the advancement of science (47 vol.)	203
The selenographical journal (3 vol.) Vierteljahrsschrift der astronomischen gesellschaft (14 vol.)	147
Bulletins de l'académie des sciences de Belgique (72 vol.)	139
Bibliographie astronomique, Lalande (1 vol.)	119

Annals, reviews, and journals, which have furnished more than a hundred articles, follow in the order of importance:—

Astronomische nachrichten (99 vol.)	1,918
Berliner astronomisches jahrbuch (107 vol.)	896
English mechanic and world of science (32 vol.)	841
Wöchentliche unterhaltungen (Jahn), continued in the Wöchenschrift für astronomie (Heis, Klein), (34 vol.)	637
The philosophical magazine (176 vol.)	550
The astronomical register (18 vol.)	525
Connaissance des temps (123 vol.)	524
Monatliche correspondenz (Zach) (28 vol.)	411
The American journal of science and arts (120 vol.)	391
Nature (23 vol.)	370
Sirius (13 vol.)	323
Histoire des ouvrages des savans (24 vol.)	301
Correspondance astronomique (Zach) (14 vol. et 1 cah.)	260
Annalen der physik und chemie (171 vol.)	211
Journal des savants (191 vol.)	189
Les mondes (5½ vol.)	184
The observatory (3 vol.)	174
Astronomisches jahrbuch (Gruithuisen) (11 vol.)	139
Cosmos (38 vol.)	113

The number of articles published per decade from 1601 to 1880 is as follows:—

1601-1610	5	1741-1750	241
1611-1620	4	1751-1760	311
1621-1630	4	1761-1770	372
1631-1640	6	1771-1780	557
1641-1650	15	1781-1790	669
1651-1660	17	1791-1800	712
1661-1670	72	1801-1810	979
1671-1680	128	1811-1820	865
1681-1690	71	1821-1830	1,188
1691-1700	74	1831-1840	1,234
1701-1710	115	1841-1850	1,732
1711-1720	108	1851-1860	2,712
1721-1730	139	1861-1870	3,838
1731-1740	255	1871-1880	6,372

This is a condensation of a more extended table (by years), which is better exhibited in

the accompanying figure of the curve of frequency of astronomical publications. Notice in the curve the dates of the discovery of Neptune (1846), of the transit of Venus (1874), of the French Revolution (1794), of the wars of Napoleon (1815), etc.

The number of authors per century is :—

1601-1700	88
1701-1800	571
1801-1880	2,901

The number of articles per century is :—

1601-1700	396
1701-1800	3,479
1801-1880	18,970

The proportion of articles per author is :—

1600-1699	4.5 articles per author.
1700-1799	6.1 " " "
1800-1880	6.6 " " "

The following list of authors who have furnished more than a hundred articles conveys its own lessons :—

	Articles.		Per year.
1. Secchi	360,	1846-1878	10.9
2. Lalande	299,	1743-1807	4.6
3. Zach, F. X. de	252,	1785-1832	5.3
4. Bessel	243,	1805-1846	5.8
5. Flammarion	210,	1863-1881	11.1
6. Birt	207,	1857-1881	8.3
7. Proctor	178,	1865-1881	10.5
8. Gruithuisen	177,	1817-1850	5.2
9. Faye	177,	1846-1881	4.9
10. Mädler	169,	1831-1870	4.2
11. Le Verrier	164,	1839-1877	4.2
12. Cassini, J. D.	143,	1664-1709	3.1
13. Wolf, R.	142,	1844-1881	3.7
14. Laplace	135,	1772-1827	2.4
15. Airy	134,	1826-1881	2.4
16. Bode	124,	1775-1826	2.4
17. Lockyer	120,	1864-1881	6.7
18. Encke	117,	1819-1865	2.5
19. Arago	110,	1814-1853	2.8
20. Delambre	107,	1783-1822	2.7
21. Heis	106,	1847-1877	3.4
22. Euler, L.	105,	1735-1783	2.1
23. Hansen	105,	1824-1874	2.1

It will be evident that this book is indispensable to every astronomical library; and the smaller the library, the more important such a work becomes. Much of the material of this work has been incorporated in another work by M. Houzeau : *Vade-mecum de l'astronome*, Brussels, 1882; 28+1,144 p. 8vo.

For each of these works, astronomy and every astronomer owes a debt of gratitude.

EDWARD S. HOLDEN.

THE FORMATION OF COAL.

Mémoire sur la formation de la houille; par Grand'Eury. Paris, Dunod. 1882. 196 p., 4 pl. 8°.

This work of Grand'Eury, reprinted from the *Annales des mines* for 1882, exposes upon

the origin of the coal such an array of facts, considerations, hypothetical subjects of inquiries, and assertions based upon long and careful researches, and these are scattered in so many chapters, that the only possible way to give an idea of the scope of the work is to quote the titles of the essential divisions.

The first part considers the botany and stratigraphy of the carboniferous formations, in seven chapters: 1°. State of disintegration of the plants; 2°. Distribution of the remains of fossil plants in the rocks; 3°. Structure of coal, and its organic composition; 4°. Trunks and stipes *in situ*; fossil forests and carboniferous forests, their relation to coal-beds; topographical circumstances; 5°. Examination of the fossil stems and of the lignite, and their comparison with coal-beds; 6°. Peat-bogs and other deposits of vegetable matters; 7°. Critical review of the divers theories on the formation of coal.

The second part treats of the physical and chemical characters as follows: 1°. State of the vegetable remains in coal; 2°. Physical properties of coal; 3°. Chemical composition; 4°. Comparison of the characters of fossil wood, lignite, and peat; 5°. Circumstances which have fostered the transformation of coal; 6°. Conclusions and *résumé*.

Each of the above chapters is subdivided into a number of sections, ninety in all, each with a title, and a short exposition of the contents. From his long researches in the coal-fields of Europe, the author comes to the conclusion that the matter composing the coal is of vegetable origin, derived from plants grown *in situ*, rapidly decomposed under atmospheric influence, more slowly transformed by maceration, and later washed out by torrential floods of rain, transported and deposited in depressions or basins surrounded by swampy forests,—the coal, in his opinion, being the result of stratification like the rocks. Besides the many other objections which could be made against this theory (a theory suggested to the author by the small areal surface occupied by the coal-deposits of France) we may mention the wide extent of the American coal-fields, and the continuity of some of the beds which cover areas of many hundred square miles, as sufficient to contradict the assertions of the distinguished author. Nevertheless, the book is very instructive as exposing a mass of facts concerning the divers phases of a formation, which, though often considered by science, are still, some of them at least, unexplained.