subsequent years would alone account for the high rank he obtained as a mathematician. . . . The mastery which he had obtained over the mathematical symbols was so complete that he never shrank from the use of expressions, however complicated—nay, the more complicated they were the more he seemed to revel in them—pro­vided they did not sin against the ruling spirit of all his work,— symmetry. To a mind imbued with the love of mathematical symmetry the study of determinants had naturally every attraction. In 1851 Mr Spottiswoode published in the form of a pamphlet an account of some elementary theorems on the subject. This having fallen out of print, permission was sought by the editor of *Crelle* to reproduce it in the pages of that journal. Mr Spottiswoode granted the request and undertook to revise his work. The sub­ject had, however, been so extensively developed in the interim that it proved necessary not merely to revise it but entirely to re­write the work, which became a memoir of 116 pages. To this, the first elementary treatise on determinants, much of the rapid development of the subject is due. The effect of the study on Mr Spottiswoode’s own methods was most pronounced ; there is scarcely a page of his mathematical writings that does not bristle with determinants.” The Royal Society’s *Catalogue of Scientific Papers* (vols. i. - viii. ) shows a list of 49 papers by Spottiswoode, to which must be added about 66 more, the titles of which have not yet been printed in that catalogue. These were published princi­pally in the *Philosophical Transactions, Proceedings of the Royal Society, Quarterly Journal of Mathematics, Proceedings of the London Mathematical Society,* and *Crelle,* aud one or two in the *Comptes Rendus* of the Paris Academy. Another list of his papers, arranged according to the several journals in which they originally appeared, with short notes upon the less familiar memoirs, is given in *Nature,* vol. xxvii. p. 599.

SPRAIN. See Surgery, p. 682, *infra.*

SPRAT, a marine fish *(Cluρea sρrattus),* named “garvie” in Scotland, one of the smallest species of the genus *Clupea* or herrings, rarely exceeds 5 inches in length, and occurs in large shoals on the Atlantic coasts of Europe. It is found also in the southern hemisphere, on the coasts of Tasmania and New Zealand, where, however, it seems to be less abundant, since its presence at the antipodes has been discovered only recently, and it does not seem to be the object of a regular fishery. Sprats are very often con­founded with young herrings, which they much resemble, but can always be distinguished by the following characters : they do not possess any teeth on the palate *(vomer),* like herrings ; their gill-covers are smooth, without the radiat­ing striæ which are found in the shad and the pilchard ; the anal fin consists of from seventeen to twenty rays, and the lateral line of forty-seven or forty-eight scales. The ven­tral fins are even with the origin of the dorsal fin ; and the spine consists of from forty-seven to forty-nine vertebræ. The sprat is one of the more important food-fishes on account of the immense numbers which are caught when the shoals approach the coasts. They are somewhat capri­cious, however, as regards the place and time of their appearance, the latter falling chiefly in the first half of winter. They are caught with the sein or with the bag- net in the tideway. Large quantities are consumed fresh, but many are pickled or smoked, and others prepared like anchovies. Frequently the captures are so large that the fish can be used as manure only.

SPREMBERG, a small town of Prussia, in the province of Brandenburg, is situated about 75 miles to the south­east of Berlin, partly on an island in the river Spree and partly on the west bank. It carries on considerable manu­factures of woollen cloth, and has greatly advanced in importance and population since the beginning of the 19th century. In 1885 its population numbered 11,011. The only building of note is the château, built by a son of Elector John George about the end of the 16th century.

SPRENGEL, Kurt (1766-1833), German botanist and physician, was born on 3d August 1766 at Boldekow in Pomerania. His father, a clergyman, provided him with a thorough education of wide scope; and the boy at an early age distinguished himself as a linguist, not only in Latin and Greek, but also in Arabic. He appeared as an author at the age of fourteen, publishing a small work

called *Anleitung zur Botanik für Frauenzimmer* in 1780. In 1784 he commenced in the university of Halle to study theology and medicine, but soon relinquished the former. He graduated in medicine in 1787. In 1789 he was ap­pointed an extraordinary professor of medicine in his *alma mater,* and in 1795 was promoted to an ordinary profes­sorship. He devoted much of his time to medical work and to investigations into the history of medicine; and he published several very valuable works in this department of knowledge, and made himself well known as one of the ablest medical men in Germany. He held a foremost rank in medicine and in botany as an original investigator, and in both published works of great value, besides numer­ous articles in scientific journals and in the proceedings of learned societies. His accomplishments as a linguist probably, in part at least, determined him in the choice of the department to which he most fully devoted himself, and in which he stood *facile princeps.* Among the more important of his many services to the science of botany was the part he took in awakening and stimulating micro­scopic investigation into the anatomy of the tissues of the higher plants, though defective microscopic appliances rendered the conclusions arrived at by himself unreliable. He also made many improvements in the details of both the Linnæan and the “ natural ” systems of classification. His life passed quietly at Halle in the pursuit of the studies dear to him, and in the enjoyment of the honours bestowed upon him by over seventy learned societies, and also by monarchs. In 1828 the death of a son, professor of surgery at Greifswald, was felt by him very severely. He experienced several apoplectic seizures, and died in one on 15th March 1833.

Subjoined is a list of the more important of his works :—*Beiträge zur Geschichte d. Pulses,* 1787; *Galeus Fieberlehre,* 1788; *Apologie des Hippokrates,* 1789; *Versuch einer pragmatischen Geschichte der Arzneikunde,* 1792-99; *Handbuch der Pathologie,* 1795-97; *In­stitutiones Medicæ,* 1809-16 (in 6 vols.); *Geschichte der Meclicin,* completed in 1820; *Antiquitatum botanicarum specimen,* 1798; *Historia rei herbariae,* 1807-8 ; *Anleitung zur Kenntniss der Gewächse,* 1802-4, and again 1817-18 ; *Geschichte der Botanik,* 1817- 18; *Von dem Bau und der Natur der Gewächse,* 1812; *Flora Halensis,* 1806-15, and in 1832; *Species umbelliferarum minus coynitæ,* 1818; *Neue Entdeckung im ganzen Umfang der Pflanzen­kunde,* 1820-22. He edited an edition of Linnaeus’s *Systema vegeta­bilium* in 1824 and of the *Genera plantarum* in 1830. His short papers are too numerous to be quoted ; a list of those in botany, from 1798 onwards, will be found in the Royal Society’s *Catalogue of Scientific Papers.*

SPRINGBOK. See Antelope, vol. ii. p. 101.

SPRINGFIELD, a city of the United States, capital of Illinois and the county seat of Sangamon county, 185 miles south-west of Chicago and 95 north-east of St Louis, at the intersection of the main lines of the. Chicago and Alton and the Wabash, St Louis, and Pacific Railways. It is situated in 39° 48' N. lat. and 89° 33' W. long., on a plateau 4 miles south of the Sangamon river. The State capitol (1868-1886) is constructed of Joliet marble in the form of a Greek cross, with porticos of granite ; it is 385 feet long and 296 wide, and has a central dome surmounted by a lantern with a ball on the pinnacle (360 feet). It contains a general library, a law library, geological and agricultural museums, and a memorial hall of the Civil War, as well as the usual Government offices. Other buildings of note are the United States executive mansion, custom-house and post-office (1866-68), and the house formerly occupied by Lincoln. In Oak Ridge cemetery, adjacent to the city, is the Lincoln monument (1874), beneath which that president was buried. The monument, designed by Larkin G. Mead, consists of a granite obelisk, reaching a height of 981/3 feet from the centre of a spacious basement (1191/2 feet long and 721/2 wide), which contains a catacomb and a memorial hall,—the latter a museum of Lincolniana. A bronze statue of Lincoln and four groups