among his last inventions was a house grate to burn gas along with coke, which he regarded as a possible cure for city smoke.

In electricity Siemens’s name is closely associated with the growth of land and submarine telegraphs, the invention and development of the dynamo, and the application of electricity to lighting and to locomotion. In 1860, with his brother Werner, he invented the earliest form of what is now known as the Siemens armature; and in 1867 he communicated a paper to the Royal Society “On the Conversion of Dynamical into Electrical Force without the aid of Permanent Magnetism,” in which he announced the invention by Werner Siemens of the dynamo-electric machine, an invention which was also reached independently and almost simultaneously by Wheatstone and by S. A. Varley. The Siemens-Alteneck or multiple-coil armature followed in 1873, and became the basis of the modern Siemens dynamo as developed, with great labour, by the firm of Siemens Brothers themselves, and (with later modi­fications) by Edison, Hopkinson, and others. While engaged in constructing a trans-Atlantic cable for the Direct United States Telegraph Company, Siemens designed the very original and suc­cessful ship “Faraday,” by which that and other cables were laid. One of the last of his works was the Portrush and Bushmills electric tramway, in the north of Ireland, opened in 1883, where the water­power of the river Bush drives a Siemens dynamo, from which the electric energy is conducted to another dynamo serving as a motor on the car. In the Siemens electric furnace the intensely hot atmosphere of the electric arc between carbon points is em­ployed to melt refractory metals. Another of the uses to which he turned electricity was to employ light from arc lamps as a sub­stitute for sunlight in hastening the growth and fructification of plants. Among his miscellaneous inventions were the differential governor already alluded to, and a highly scientific modification of it, described to the Royal Society in 1866; a water-meter which acts on the principle of counting the number of turns made by a small reaction turbine through which the supply of water flows; an electric thermometer and pyrometer, in which temper­ature is determined by its effect on the electrical conductivity of metals; an attraction meter for determining very slight variations in the intensity of a gravity; and the bathometer, by which he applied this idea to the problem of finding the depth of the sea without a sounding line. In a paper read before the Royal Society in 1882 “On the Conservation of Solar Energy,” he suggested a bold but unsatisfactory theory of the sun’s heat, in which he sought to trace on a cosmic scale an action similar to that of the regenera­tive furnace. His fame, however, does not rest on his contribu­tions to pure science, valuable as some of these were. His strength lay in his grasp of scientific principles, in his skill to perceive where and how they could be applied to practical affairs, in his zealous and instant pursuit of thought with action, and in the in­domitable persistence with which he clung to any basis of effort that seemed to him theoretically sound.

Siemens’s writings consist for the most part of lectures and papers scattered through the scientific journals and the publications of the Royal Society, the Institution of Civil Engineers, the Institute of Mechanical Engineers, the Iron and Steel Institute, the British Association, &c. A biography by Dr William Pole is now (1886) in preparation. (J. A. E.)

SIENA, a city of Italy, and one of the most character­istic of Tuscany, stands (43° 19' N. lat., 11° 19' E. long.) on a hill near the mountainous region of Chianti, the Maremma, and Val di Chiana. It is 60 miles by rail south of Florence and 160 north-west of Rome. The area of the city within the walls is about 21/2 square miles and its population in 1881 was 25,204. The province of Siena, comprising about 1467 square miles, with 37 com­munes, and a total population of 207,000, by the political redistribution of 1882 forms a single electoral college and returns four members to parliament. The diocese of Siena, an archbishopric dating from 1459, includes 18 city and 95 rural parishes divided into 12 vicariates.

The city possesses a university, founded in 1203 and limited to the faculties of law and medicine. Among the other public institutions the following are the more im­portant:—the town library, first opened to students in the 17th century; the Archivio, a record office, instituted in 1858, containing a valuable and splendidly arranged col­lection of documents; the Fine Arts Institution, founded in 1816; and the natural history museum of the Royal Academy of the Physiocritics, inaugurated in the same year. There are also many flourishing charities, including an excellent hospital and a school for the deaf and dumb.

The public festivals of Siena known as the “Palio delle Contrade” have a European celebrity. They are held in

the public square, the curious and historic Piazza del Campo (now Piazza di Vittorio Emanuele), on 2d July and 16th August of each year; they date from the Middle Ages and were instituted in commemoration of victories and in honour of the Virgin Mary (the old title of Siena, as shown by seals and medals, having been “Sena vetus civitas Virginis”). In the 15th and 16th centuries the celebrations consisted of bull-fights. At the close of the 16th century these were replaced by races with mounted buffaloes, and since 1650 by (ridden) horses. Siena is divided into seventeen *contrade* (wards), each with a dis­tinct appellation and a chapel and flag of its own; and every year ten of these *contrade,* chosen by lot, send each one horse to compete for the prize *palio* or banner. The aspect of Siena during these meetings is very character­istic, and the whole festivity bears a mediæval stamp in harmony with the architecture and history of the town.

Among the noblest fruits of Sienese art are the public build­ings adorning the city. The cathedral, one of the finest examples of Italian Gothic architecture, was begun in the early years of the 13th century, and in 1317 its walls were extended to the baptistery of San Giovanni; a further enlargement was begun in 1339 but never carried out, and a few ruined walls and arches alone remain to show the magnificence of the uncompleted design. The splendid west front, of tricuspidal form, enriched with a multitude of columns, statues, and inlaid marbles, was finished in 1380. Space

fails for the enumeration of the art treasures of the interior, but conspicuous among them is the well-known octagonal pulpit by Niccolò Pisano, dating from about 1274. The cathedral pavement is almost unique. It is inlaid with designs in colour and black and white, representing Biblical and legendary subjects, and is supposed to have been begun by Duccio della Buoninsegna. But the finest portions beneath the domes, with scenes from the history of Abra­ham, Moses, and Elijah, are by Domenico Beccafumi and are exe­cuted with marvellous boldness and effect. The choir stalls also deserve mention: the older ones (remains of the original choir) are in *tarsia* work; the others, dating from the 16th century, are carved from Riccio's designs. The Piccolomini Library, adjoining the *duomo,* was founded by Cardinal Francesco Piccolomini-Todeschini