the Vistula is mostly wide, with several terraces covered with sand-dunes or peat-bog. Siedlce is watered by the Vistula, which borders it for 50 miles on the west; the Bug, which is navigable from Opalin and flows for 170 miles on the east and north-east borders of the province; the Wieprz, a tributary of the Vistula, which is also navi­gable, and flows for 25 miles along the southern boundary; and the Liwiec, a tributary of the Bug, which is navigable for some 30 miles below Wengroff.

Of the total surface of the government only 184,760 acres are unproductive; 695,420 acres are covered with forests; 1,703,100 are under crops, and 611,260 under meadows and pasture land. The population only increases at the rate of 0∙75 per cent. a year, and in 1884 numbered 630,240; of these Poles constituted 39∙7 per cent., Little Russians 43∙1, Jews 151, and Germans about 2. According to religious belief they were distributed as follows:— out of 616,649 inhabitants in 1882 there were 367,187 Catholics, 142,945 Orthodox Greeks, 96,764 Jews, 8892 Protestants, 505 Baptists, and 356 Mohammedan Tatars. Agriculture is the chief occupation; in 1881 the crops yielded 1,531,400 quarters of corn and 10,988,400 bushels of potatoes. Cattle-breeding is in a relatively flourishing state, there being (1881) 57,500 horses, 292,670 horned cattle, 461,700 sheep, and 194,100 pigs. Manufactures are insigni­ficant (2270 workmen); their aggregate production, chiefly from distilleries and breweries, was valued at £394,820 in 1881. Trade also is insignificant, although Siedlce has four railways, one of which, from Warsaw to Brest-Litovsk, crosses it from west to east. There are two gymnasia for boys (at Siedlce and Biata), one gymna­sium for girls, one seminary for teachers (at Biata), and about 240 primary schools with 11,260 scholars. The government is divided into nine districts, the chief towns of which, with their populations in 1882, are—Siedlce (see below), Biała (19,435), Constantinoff (3200), Garvolin (14,620), Łukoff (11,030), Radzyn (4440), Sokotoff (6300), Wengroff (8140), and Włodawa (17,985). Janoff (3030), where a state stud is kept, has also municipal institutions.

SIEDLCE, capital of the above government, is situated 57 miles east-south-east of Warsaw, on the Brest-Litovsk Railway. It received municipal institutions in 1547. The Oginskis, to whom it belonged, have embellished it with a palace and gardens; but it is still nothing more than a large village, where the provincial authorities have their seat. Its population was 12,950 in 1882.

SIEGE. See Fortification.

SIEGEN, an ancient mining and manufacturing town of Prussia, in the province of Westphalia, is situated 47 miles to the east of Cologne on the Sieg, a tributary entering the Rhine opposite Bonn. The surrounding dis­trict, to which it gives its name, abounds in iron-mines, so that iron founding and smelting are important branches of industry in and near the town. Large tanneries and leather-works, and factories for cloth paper, and machinery, are among the other industrial establishments. The popu­lation in 1880 was 15,024, of whom 3632 were Roman Catholics and 111 Jews.

Siegen was the capital of an early principality belonging to the house of Nassau; and from 1606 onwards it gave name to the junior branch of Nassau-Siegen. Napoleon incorporated Siegen in the grand-duchy of Berg in 1806; and in 1815 the congress of Vienna assigned it to Prussia, under whose rule it has nearly quintupled its population. Rubens is said to have been born here in 1577.

SIEGFRIED. See Nibelungenlied, vol. xvii. p. 475.

SIEMENS, Sir William (1823-1883), christened Carl Wilhelm, an eminent inventor, engineer, and natural philo­sopher, was born at Lenthe in Hanover on 4th April 1823. After being educated in the polytechnic school of Magde­burg and the university of Göttingen, he visited England at the age of nineteen, in the hope of introducing a process in electro-plating invented by himself and his brother Werner. The invention was adopted by Messrs Elking- ton, and Siemens returned to Germany to enter as a pupil the engineering works of Count Stolberg at Magdeburg. In 1844 he was again in England with another invention, the “chronometric” or differential governor for steam- engines (see Steam-Engine). Finding that British patent laws afforded the inventor a protection which was then wanting in Germany, he thenceforth made England his

home; but it was not till 1859 that he formally became a naturalized British subject. After some years spent in active invention and experiment at mechanical works near Birmingham, he went into practice as an engineer in 1851. He laboured mainly in two distinct fields, the applications of heat and the applications of electricity, and was charac­terized in a very rare degree by a combination of scientific comprehension with practical instinct. In both fields he played a part which would have been great in either alone; and, in addition to this, he produced from time to time miscellaneous inventions and scientific papers sufficient in themselves to have established a reputation. His posi­tion was recognized by his election in 1862 to the Royal Society, and later to the presidency of the Institute of Mechanical Engineers, the Society of Telegraph Engineers, the Iron and Steel Institute, and the British Association; by honorary degrees from the universities of Oxford, Glasgow, Dublin, and Würzburg; and by knighthood. He died in London on the 19th of November 1883.

In the application of heat Siemens’s work began just after Joule’s experiments had placed the doctrine of the conservation of energy on a sure basis. While Rankine, Clausius, and Thomson were de­veloping the dynamical theory of heat as a matter of physical and engineering theory, Siemens, in the light of the new ideas, made a bold attempt to improve the efficiency of the steam-engine as a converter of heat into mechanical work. Taking up the regenerator —a device invented by Stirling twenty years before, the importance of which had meanwhile been ignored—he applied it to the steam- engine in the form of a regenerative condenser with some success. This was in 1847, and in 1855 engines constructed on Siemens’s plan were worked at the Paris exhibition. Later he made many attempts to apply the regenerator to internal-combustion or gas engines; but neither in steam-engines nor in gas-engines were his inventions directly and permanently fruitful, though the direction they followed is that in which improvement is still looked for. The regenerative principle, however, as a means of economizing heat soon received at his hands another and far wider application. In 1856 he introduced the regenerative furnace, the idea of his brother Friedrich, with whom William associated himself in directing its applications. In an ordinary furnace a very large part of the heat of combustion is lost by being carried off in the hot gases which pass up the chimney. In the regenerative furnace the hot gases pass through a regenerator, or chamber stacked with loose bricks, which absorb the heat. When the bricks are well heated the hot gases are diverted so to pass through another similar chamber, while the air necessary for combustion, before it enters the furnace, is made to traverse the heated chamber, taking up as it goes the heat which has been stored in the bricks. After a suitable interval the air currents are again reversed. The process is repeated period­ically, with the result that the products of combustion escape only after being cooled, the heat which they take from the furnace being in great part carried back in the heated air. But another invention was required before the regenerative furnace could be thoroughly successful. This was the use of gaseous fuel, produced by the crude distillation and incomplete combustion of coal in a distinct furnace, now known as Siemens’s gas-producer. From this the gaseous fuel passes by a flue to the regenerative furnace, and it, as well as the entering air, is heated by the regenerative method, four brick-stacked chambers being used instead of two. The com­plete invention was applied at Chance’s glass-works in Birmingham in 1861, and furnished the subject of Faraday’s farewell lecture to the Royal Institution. It was soon applied to many industrial processes, but it found its greatest development a few years later at the hands of Siemens himself in the manufacture of steel. To produce steel directly from the ore, or by melting together wrought- iron scrap with cast-iron upon the open hearth, had been in his mind from the first, but it was not till 1867, after two years of experiment in “sample steel works” erected by himself for the purpose, that he achieved success. The modern forms of the Siemens steel process are described in the article Iron (vol. xiii. p. 347 *sq.*)*.* The product is a mild steel of exceptionally trust­worthy quality, the use of which for boiler-plates has done much to make possible the high steam-pressures that are now common, and has consequently contributed, indirectly, to that improvement in the thermodynamic efficiency of heat engines which Siemens had so much at heart. Just before his death he was again at work upon the same subject, his plan being to use gaseous fuel from a Siemens producer in place of solid fuel beneath the boiler, and to apply the regenerative principle to boiler furnaces. His faith in gaseous fuel led him to anticipate that its use would in time supersede that of solid coal for domestic and industrial purposes, cheap gas being supplied either from special works or direct from the pit; and