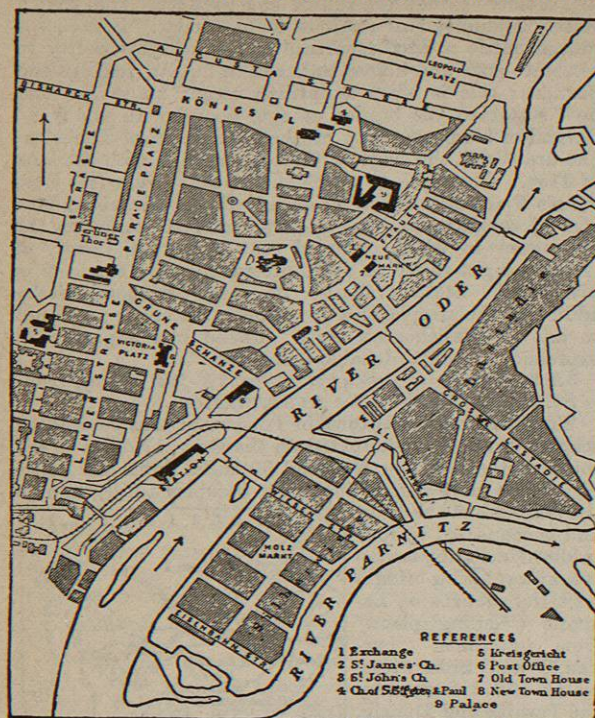


that of the Vulcan Company deserves mention) have comparatively recently attained some reputation for their iron-clads and war-vessels. Machinery, cement, chemicals, and soap are produced in large quantities, and there are also



Plan of Stettin.

large sugar-refineries, besides a vast miscellany of other smaller industrial establishments. The trade of Stettin is very flourishing. More than any other harbour it may be regarded as the port of Berlin, from which it is 93 miles north-east by railway; and a larger number of vessels enter and clear at Stettin than at any other German port except Hamburg and Bremerhaven. SWINEMÜNDE (*q.v.*) serves as its fore-port. The forest and river scenery of the neighbourhood of Stettin is picturesque, but the low level and swampy nature of the soil render the climate bleak and unhealthy. In 1885 the population was 99,475; in 1880 it was 91,756, of whom 85,727 were Protestants, 3112 Roman Catholics, and 2388 Jews.

In 1885 3809 ocean vessels (2207 steamers) and 1965 coasting and river craft, besides 10,039 Oder barges, entered the port. In 1885 Stettin possessed (besides a large number of river craft) a fleet of 127 sea-going ships, with a burden of 47,066 tons, of which 26,754 tons were distributed in 59 steamers. The chief exports are grain, spirits, and wood; the chief imports petroleum, train-oil, wine, and herrings. The annual value of the former is about £7,500,000 and of the latter about £6,000,000.

Stettin is said to have existed as a Wendish fishing-village as early as 830 A.D., and it appears as Stedyn in the time of the Saxon emperors. From the 12th century it was the seat of the dukes of Pomerania, who became extinct in 1637. Passing then to Sweden, it remained united with that kingdom for eighty-three years, with one brief interval, but in 1720 it was ceded to Prussia. Gustavus Adolphus undertook to improve its fortifications in 1630, but Frederick the Great was the first to convert it into a strong modern fortress. From 1806 till 1813 it was held by the French, to whom it was surrendered without a blow. Known even in the 12th century as the leading trading-town on the Oder, Stettin entered the Hanseatic League in 1360. The development of its trade in modern times dates chiefly from the deepening and protection of the Swine in the former half of last century. See ODER.

STEUART, SIR JAMES DENHAM (1712-1780), BART., author of *An Inquiry into the Principles of Political Economy* (see POLITICAL ECONOMY, vol. xix. p. 365), was the only son of Sir James Steuart, solicitor-general for Scotland under Queen Anne and George I., and was born at Edinburgh on October 21, 1712. After passing through the university of Edinburgh he was admitted to the Scottish bar at the age of twenty-four. He then spent some years on the Continent, and while in Rome entered into relations with the Pretender. He was in Edinburgh in 1745, and so compromised himself that after the battle of Culloden he found it necessary to return to the Continent, where he remained until 1763. It was not indeed until 1771 he was fully pardoned for any complicity he may have had in the rebellion. He died at his family seat, Coltness, in Lanarkshire, on November 26, 1780.

The Works, Political, Metaphysical, and Chronological, of the late Sir James Steuart of Coltness, Bart., now first collected, with Anecdotes of the Author, by his Son, General Sir James Denham Steuart, were published in 6 vols. 8vo in 1805. Besides the *Inquiry* (originally published in 2 vols. 4to in 1767), they include—*A Dissertation upon the Doctrines and Principles of Money applied to the German Coin* (1753), *Apologie du Sentiment de M. le Chevalier Newton sur l'Antienne Chronologie des Grecs* (4to, Frankfurt-on-the-Main, 1757), *The Principles of Money applied to the Present State of Bengal*, published at the request of the East India Company (4to, 1772), *A Dissertation on the Policy of Grain* (1783), *Plan for Introducing Uniformity in Weights and Measures within the Limits of the British Empire* (1790), *Observations on Beattie's Essay on Truth*, *A Dissertation concerning the Motive of Obedience to the Law of God*, and other treatises.

STEBENVILLE, a city of the United States, county seat of Jefferson county, Ohio, lies 43 miles west of Pittsburgh, on the west bank of the Ohio river, here a third of a mile wide and crossed by a railway bridge. Built above a productive coalfield, and with an abundant supply of natural gas for fuel purposes, Steubenville has naturally become a manufacturing centre (foundries, rolling-mills, nail and glass factories, potteries, machine-shops, flour-mills, &c.), and as the surrounding district is a good farming, wool-growing, and stock-raising country it is the seat of considerable commercial activity. The court-house is a particularly fine building. In 1870 the population was 8107, in 1880 12,093. Steubenville, so called after Baron Steuben, one of Washington's generals, grew up round a fort erected in 1787. It became a city in 1851.

STEVENS, ALFRED. See SCULPTURE, vol. xxi. p. 561.

STEVENS, THADDEUS (1792-1868), was born at Peacham, Vermont, U.S., April 4, 1792, graduated at Dartmouth College in 1814, and then settled in Pennsylvania. He soon became a leading lawyer of Lancaster, Pa., so far interested in politics as to be elected by the Whig party to the State legislature for several terms and to the federal house of representatives 1849-63. When the mass of the Northern Whig party went into the new Republican party he went with it, and returned to Washington as a Republican representative in 1859, just before the outbreak of the Civil War. This position he retained until his death, just outlasting the Civil War and reconstruction. During this period of American history he was one of the leading characters. The methods on which he proposed to conduct the war were always drastic: the wholesale confiscation of lands in the seceding States, the disfranchisement of insurgent citizens, the emancipation and enfranchisement of the negroes, all found in him their earliest and warmest advocate. While other parties and leaders were continually shifting their ground, changing their theories of the relations of the Union to the seceding States as the struggle grew more intense, Stevens was consistent from beginning to end. The almost universal theory was that the war was prosecuted only to enforce the constitution; it was therefore incumbent on those who prosecuted it to obey the constitution punctiliously, how-

ever puzzling might be the difficulties into which it led them. Stevens, on the contrary, insisted that armed resistance to the constitution had the effect of suspending the constitution within the area of the resistance; that the success of the resistance would show whether the suspension was to be temporary or permanent; and that, in the meantime, those who resisted the constitution were entitled to no rights under it,—in fact, to no rights except those reserved under the laws of war. This was too radical even for the war party; but, at the end of the war, Stevens's pronounced ability gave him the leadership of the house committee on reconstruction. Even in this position, he never obtained a formal endorsement of his theory; but the practical management of reconstruction shows its strong influence in many features otherwise inexplicable. He lived to take a leading part in the unsuccessful impeachment of President Johnson, and to see the admission of the first instalment of reconstructed States, and died at Washington, August 11, 1868.

Stevens's life has been written from a friendly and from a hostile point of view,—the former in the volume entitled *Thaddeus Stevens, Commoner*, the latter in Harris's *Political Conflict in America*.

STEVENSON, ROBERT (1772-1850), civil engineer, was the only son of Alan Stevenson, partner in a West Indian house in Glasgow, and was born in that city 8th June 1772. Having lost his father in infancy, he removed with his mother to Edinburgh. In his youth he assisted his stepfather, Thomas Smith, in his lighthouse schemes, and at the early age of nineteen was sent to superintend the erection of a lighthouse on the island of Little Cumbrae. During successive winters he attended classes at Anderson's College, Glasgow, and at Edinburgh university. He succeeded his stepfather, whose daughter he married in 1799, as engineer to the Board of Northern Lighthouses, and at the same time began general practice as a civil engineer. During his period of office from 1797 to 1843, he designed and executed no fewer than eighteen lighthouses, the most important being that on the Bell Rock, begun in 1807 and completed in 1810, in which he improved considerably on the designs of Smeaton for the Eddystone lighthouse (see LIGHTHOUSE, vol. xiv. p. 616). For its illumination he introduced an improved apparatus; he was also the author of various other valuable inventions in connexion with lighting, including the intermittent and flashing lights, and the mast lantern for ships. In his general practice as a civil engineer he was employed in the construction of many county roads, in various important improvements in connexion with the approaches to Edinburgh, including that by the Calton Hill, in the erection of slips at ferries, in the construction of harbours, docks, and breakwaters, in the improvement of river and canal navigation, and in the construction of several important bridges. It was he that brought into notice the superiority of malleable iron rods for railways over the old cast iron, and he was the inventor of the movable jib and balance cranes. It was chiefly through his interposition that an Admiralty survey was established, from which the Admiralty sailing directions for the coasts of Great Britain and Ireland have been prepared. Stevenson was elected a fellow of the Royal Society of Edinburgh in 1815, and afterwards became a member of the Geological and Astronomical Societies of London and the Wernerian and Antiquarian Societies of Scotland. He published an account of the Bell Rock lighthouse in 1824, and, besides contributing important articles on engineering subjects to Brewster's *Edinburgh Encyclopædia* and the *Encyclopædia Britannica*, was the author of various papers read before the societies he was connected with. He died at Edinburgh 12th July 1850.

A Life of Robert Stevenson, by his son David Stevenson, appeared in 1878. David Stevenson (1815-86), who along with

his brother Alan succeeded to his father's business, was the author of a *Sketch of the Civil Engineering of North America* (1838, republished in "Weale's Series," 1859), *Marine Surveying* (1842), *Canal and River Engineering* (1858; 2d ed. enlarged, 1872; 3d ed. 1886), and of various papers read before learned societies.

STEVINUS, SIMON (1548-1620). This great mathematician was born in 1548 at Bruges (where the Place Simon Stevin contains his statue by Eugen Simonis) and died in 1620 at The Hague or in Leyden. Of the circumstances of his life very little is recorded; the exact day of his birth and the day and place of his death are alike uncertain. It is known that he left a widow with two children; and one or two hints scattered throughout his works inform us that he began life as a merchant's clerk in Antwerp, that he travelled in Poland, Denmark, and other parts of northern Europe, and that he was intimate with Prince Maurice of Orange, who asked his advice on many occasions, and made him a public officer,—at first director of the so-called "waterstaet," and afterwards quartermaster-general. The question whether Stevinus, like most of the rest of the prince's followers, belonged to the Protestant creed hardly admits of a categorical answer. A Catholic, it may be said, would never in those times have risen to so high a position. A Catholic would perhaps not have been so ready as Stevinus to deny the value of all authority, whether of an Aristotle, of an Euclid, or of a Vitruvius. A Catholic could not well have boasted, as Stevinus in a political pamphlet did, that he had always been in harmony with the executive power. But against these considerations it might be urged that a Protestant had no occasion to boast of a harmony most natural to him, while his further remark, in the same pamphlet, to the effect that a state church is indispensable, and that those who cannot belong to it on conscientious grounds ought to leave the country rather than show any opposition to its rites, seems rather to indicate the crypto-Catholic, who wishes for reasons of his own to remain in the Netherlands. The same conclusion is supported by the ascertained fact that Stevinus, a year before his death, bequeathed a pious legacy to the church of Westkerke in Flanders, out of the revenues of which masses were to be said. But, however it may be answered, the question is fortunately of little importance to us, as Stevinus was neither a political personage nor did he engage in religious controversy. He was mainly, as already said, a great mathematician, and it is chiefly in this quality that we must try to get acquainted with him. His claims to fame are most varied. Some of them appealed strongly to the men of his time, but many were such as could not well be understood by most of his contemporaries, and have found due acknowledgment only in later times.

His contemporaries were most struck by his invention of a carriage with sails, a little model of which was preserved at Scheveningen till 1802. The carriage itself had been lost long before; but we know that about the year 1600 Stevinus, with Prince Maurice of Orange and twenty-six others, made use of it on the sea-shore between Scheveningen and Petten, that it was propelled solely by the force of the wind, and that it acquired a speed which exceeded that of horses. Another idea of Stevinus, for which even Grotius gave him great credit, was his notion of a bygone age of wisdom. Mankind once knew everything knowable, but gradually forgot most of it, till a time came when little by little the forgotten knowledge was reacquired; the goal to be aimed at is the bringing about of a second age of wisdom, in which mankind shall have recovered all its early knowledge. The fellow-countrymen of Stevinus were proud that he wrote in their own dialect, which he thought fitted for a universal language, as no other abounded like Dutch in monosyllabic radical words.

History has been much less enthusiastic than his con-

temporaries in admiring these claims to fame, but it has discovered in Stevinus's works various inventions which did not at once receive the notice they deserved. He was the first to show how to fashion regular and semiregular polyhedra by delineating their frames in a plane. Stevinus also distinguished stable from unstable equilibrium. He proved the law of the equilibrium on an inclined plane. He demonstrated before Varignon the resolution of forces, which, simple consequence of the law of their composition though it is, had not been previously remarked. He discovered the hydrostatic paradox that the downward pressure of a liquid is independent of the shape of the vessel, and depends only on its height and base. He also gave the measure of the pressure on any given portion of the side of a vessel. He had the idea of explaining the tides by the attraction of the moon.

It remains to enumerate those claims of Stevinus to immortality which were recognized from the first and which succeeding ages have not lessened,—his writings on military science, on book-keeping, and on decimal fractions.

That the man who was quartermaster-general to Matrice of Orange should have been possessed of more than ordinary merit, and have left behind him military papers of lasting value, is hardly more than might have been expected. This expectation, in the case of Stevinus at least, is fully borne out in the opinion of competent judges. Prince Maurice is known as the man who conquered the greatest number of fortresses in the shortest time, and fortification was the principal aim of his adviser. Stevinus seems to be the first who made it an axiom that strongholds are only to be defended by artillery, the defence before his time having relied mostly on small firearms. He wrote upon temporary fortifications, but the excellence of his system was only slowly discerned. He was the inventor of defence by a system of sluices, which proved of the highest importance for the Netherlands. His plea for the teaching of the science of fortification in universities, and the existence of such lectures in Leyden, have led to the impression that he himself filled this chair; but the belief is quite erroneous, as Stevinus, though living at Leyden, never had direct relations with its university.

Book-keeping by double entry may have been known to Stevinus as clerk at Antwerp either practically or through the medium of the works of Italian authors like Paccioli and Cardan. He, however, was the first to recommend the use of impersonal accounts in the national household. He practised it for Maurice, and recommended it in a small pamphlet to Sully the French statesman; and, if public book-keeping has grown more and more lucid by the introduction of impersonal accounts, it is certainly to Stevinus that the credit of the improvement is due.

His greatest success, however, was a small pamphlet, first published in Dutch in 1586, and not exceeding seven pages in the French translation (which alone we have seen). This translation is entitled *La Disme, enseignant facilement expédier par Nombres Entiers sans rompus, tous Comptes se rencontrans aux Affaires des Hommes*. Decimal fractions had been employed for the extraction of square roots some five centuries before his time, but nobody before Stevinus established their daily use; and so well aware was he of the importance of his innovation that he declared the universal introduction of decimal coinage, measures, and weights to be only a question of time. His notation is rather unwieldy. The point separating the integers from the decimal fractions seems to be the invention of Bartholomæus Pitiscus, in whose trigonometrical tables (1612) we have found it, and it was accepted by Napier in his logarithmic papers (1614 and 1619). Stevinus printed little circles round the ex-

ponents of the different powers of one-tenth. For instance, $237\frac{578}{1000}$ was printed $237 \textcircled{0} 5 \textcircled{1} 7 \textcircled{2} 8 \textcircled{3}$; and the fact that Stevinus meant those encircled numerals to denote mere exponents is evident from his employing the very same sign for powers of algebraic quantities, e.g., $9 \textcircled{4} - 14 \textcircled{3} + 6 \textcircled{2} - 5$ to denote $9x^4 - 14x^3 + 6x^2 - 5$. He does not even avoid fractional exponents ("Racine cubique de $\textcircled{2}$ serait $\frac{2}{3}$ en circle"), and is ignorant only of negative exponents. Powers and exponents have also been carried back to a period several centuries earlier than Stevinus, and it is not here intended to give him any undue credit for having maintained them; but we believe it ought to be recognized more than it generally is, that for our author there was a connexion between algebraic powers and decimal fractions, and that even here Stevinus the profound theorist is not lost to view behind Stevinus the man of brilliant practical talents. (M. CA.)

STEWART, or STUART. For the royal house of this name, see STUART.

STEWART, DUGALD (1753-1828), one of the most influential of the Scottish philosophers, was born at Edinburgh on the 22d of November 1753. His father, Matthew Stewart (1715-85), was professor of mathematics in the university of Edinburgh from 1747 till 1772, and was an eminent investigator in his own department, applying the geometrical methods of Simson, who had been his teacher in Glasgow. Dugald Stewart's early years were passed partly in Edinburgh and partly at Catrine in Ayrshire, where his father had a small property, to which the family removed every summer on the close of the academical session. Burns was an occasional visitor at Catrine, which is only a few miles from Mossgiel; and the philosopher and the poet had various meetings as well as some slight correspondence in later years. Dugald Stewart was educated at the high school and university of his native town. At school he laid the foundation of the classical knowledge and literary taste which are conspicuous in his works, and which lent a charm to his prelections. At the university his chief subjects were the mathematical sciences—in which he attained great proficiency—and philosophy. Adam Ferguson, the historian of the Roman republic, was then professor of moral philosophy in Edinburgh, and his bracing ideal of ethical and political virtue commended itself highly to Stewart. In 1771, having thoughts of entering the English Church, Stewart proceeded to Glasgow with a view to the Snell exhibitions tenable by Glasgow students at Oxford. Here he listened to the lectures of Reid, whose *Inquiry*, published seven years before, had laid the effective foundation of what is called distinctively the Scottish philosophy. Reid became Stewart's acknowledged master and also his friend, while Stewart's academic eloquence and powers of elegant exposition gained for their common doctrines a much wider acceptance than they could have secured in the clumsy and less attractive presentation of Reid himself. In Glasgow Stewart boarded in the same house with Archibald Alison, afterwards author of the *Essay on Taste*, and a close friendship sprang up between them, which remained unbroken through life. After no more than a single session in Glasgow, Dugald Stewart was summoned by his father, whose health was beginning to fail, to conduct the mathematical classes in the university of Edinburgh. Though only nineteen years of age he discharged his duties with marked ability and success; and after acting three years as his father's substitute he was elected professor of mathematics in conjunction with him in 1775. Three years later Adam Ferguson was appointed secretary to the commissioners sent out to the American colonies, and at his urgent request

Stewart lectured as his substitute. Thus during the session 1778-79, in addition to his mathematical work, he delivered an original course of lectures on morals. "To this season," says his son, "he always referred as the most laborious of his life; and such was the exhaustion of the body from the intense and continued stretch of the mind that on his departure for London at the close of the academical session it was necessary to lift him into the carriage." In 1783 Stewart married Helen Bannatyne, who died in 1787, leaving an only son, Colonel Matthew Stewart, from whose short memoir of his father the above is a quotation.

In 1785, on the resignation of Ferguson, he was transferred to the chair of moral philosophy, which he filled for a quarter of a century and made a notable centre of intellectual and moral influence. Young men of rank and of parts were attracted by his reputation from England, and even from the Continent and America. A very large number of men who afterwards rose to eminence in literature or in the service of the state were thus among his students. Sir Walter Scott, Jeffrey, Cockburn, Francis Horner, Sydney Smith, Lord Brougham, Dr Thomas Brown, James Mill, Sir James Mackintosh, and Sir Archibald Alison may be mentioned among others. There is a unanimous testimony to the attractive eloquence of Stewart's lectures and the moral elevation of his teaching. "Dugald Stewart," says Lord Cockburn, "was one of the greatest of didactic orators. Had he lived in ancient times, his memory would have descended to us as that of one of the finest of the old eloquent sages. No intelligent pupil of his ever ceased to respect philosophy, or was ever false to his principles, without feeling the crime aggravated by the recollection of the morality that Stewart had taught him." Dr John Thomson, afterwards medical professor in Edinburgh, was accustomed to say that the two things by which he had been most impressed in the course of his life were the acting of Mrs Siddons and the oratory of Dugald Stewart. Lord Cockburn, in his *Memoirs*, has left an interesting portrait of Stewart's appearance and manner:—"Stewart was about the middle size, weakly-limbed, and with an appearance of feebleness which gave an air of delicacy to his gait and structure. His forehead was large and bald, his eyebrows bushy, his eyes grey and intelligent, and capable of conveying any emotion from indignation to pity, from serene sense to hearty humour, in which they were powerfully aided by his lips, which, though rather large perhaps, were flexible and expressive. The voice was singularly pleasing; and, as he managed it, a slight burr only made its tones softer. His ear, both for music and for speech, was exquisite; and he was the finest reader I have ever heard. His gesture was simple and elegant, though not free from a tinge of professional formality; and his whole manner was that of an academical gentleman, . . . calm and expository, but rising into greatness or softening into tenderness whenever his subject required it." The course on moral philosophy embraced, besides ethics proper, lectures on political philosophy or the theory of government, and from 1800 onwards a separate course of lectures was delivered on political economy. These last were extremely important in spreading a knowledge of the fundamental principles of the science at a time when they were still almost unknown to the general public. Stewart's enlightened political teaching was sufficient, in the times of reaction succeeding the French Revolution, to draw upon him the undeserved suspicion of disaffection to the constitution.

In 1790 Stewart married a second time. Miss Cranston, who became his wife, was a lady of birth and accomplishments, and he was in the habit of submitting to her

criticism whatever he wrote. A son and a daughter were the issue of this marriage. The death of the former in 1809 was a severe blow to the failing health of his father, and was the immediate cause of his retirement from the active duties of his chair. Before that, however, Stewart had not been idle as an author. In 1792 he published the first volume of the *Elements of the Philosophy of the Human Mind*; the second volume appeared in 1814, and the third not till 1827. In 1793 he printed a text-book, *Outlines of Moral Philosophy*, which went through many editions; and in the same year he read before the Royal Society of Edinburgh his account of the *Life and Writings of Adam Smith*. Similar memoirs of Robertson the historian and of Reid were afterwards read before the same body and appear in his published works. In 1805 Stewart took an active part in what was known as the Leslie case, that is to say, the public controversy arising out of the appointment of Mr (afterwards Sir John) Leslie to the chair of mathematics in the university of Edinburgh. Leslie was attacked by the presbytery of Edinburgh, ostensibly on account of his views on the nature of causal connexion, which were said to approximate to Hume's. In two pamphlets Stewart defended Leslie's doctrine as philosophically tenable and theologically innocuous. In 1806 he received in lieu of a pension the nominal office of the writership of the *Edinburgh Gazette*, with a salary of £300. When the shock of his son's death incapacitated him from lecturing during the session of 1809-10, his place was taken, at his own request, by Dr Thomas Brown, who in 1810 was appointed conjoint professor. On the death of Brown in 1820, Stewart, who had taken no further active part in lecturing, retired altogether from the professorship, which was conferred upon John Wilson, better known as "Christopher North." From 1809 onwards Stewart lived mainly at Kinneil House, Linlithgowshire, which was placed at his disposal by the duke of Hamilton. From this retirement he continued to send forth a succession of works. In 1810 appeared *Philosophical Essays*, in 1814 the second volume of the *Elements*, in 1815 the first part and in 1821 the second part of the "Dissertation" written for the *Encyclopædia Britannica* "Supplement," entitled "A General View of the Progress of Metaphysical, Ethical, and Political Philosophy since the Revival of Letters." In 1822 he was struck with paralysis, but recovered a fair degree of health, sufficient to enable him to resume his studies. In 1827 he published the third volume of the *Elements*, and, in 1828, a few weeks before his death, *The Philosophy of the Active and Moral Powers*. He died in Edinburgh after a short illness on the 11th of June 1828. A monument to his memory was erected on the Calton Hill by his friends and admirers.

An edition of his *Collected Works*, in eleven volumes (1854-58), was edited by Sir William Hamilton, on whose death in 1856 it was carried to completion and furnished with a memoir of Stewart by Prof. Veitch. Stewart was an elegant writer rather than a profound or original thinker, and he cannot be said to have added much to the philosophy of Reid (see REID), though he contributed very largely to its dissemination. His psychological observations, however, are acute and varied, and his general powers of mind contributed largely to elevate the study of philosophy in the United Kingdom. His reputation rests more upon the tradition of his inspiring and elevating eloquence than upon any definite achievements within the province of philosophy proper. (A. SE.)

STEYR, STEIER, or STEYER, an industrial town in Upper Austria, is situated on an island at the junction of the Steyr and Enns, 20 miles to the south of Linz and 92 miles to the west-south-west of Vienna. The main town is connected by two bridges with the suburbs of Steyrdorf and Ennsdorf. The Gothic parish church was built in 1443; the town-house is modern. The interesting old castle of the princes of Lamberg, dating from the 10th century, rises on an eminence near the town. Steyr

is one of the chief seats of the iron and steel industry in Upper Austria (Austria, vol. iii. p. 120), and very large quantities of cutlery, scythes, sickles, and edge-tools are annually produced in the town and neighbourhood. The Werndl small-arms factory, now carried on by a joint-stock company, and employing 4500 hands, is the largest in Austria. The population in 1880 was 17,199. Steyr was the capital of an early countship or grafschaft, at first belonging to Styria, but annexed to Austria in 1192.

STICKLEBACK is the name applied to a group of small fishes (*Gastrosteus*) which inhabit the fresh and brackish waters as well as the coasts of the temperate zone of the northern hemisphere. Although some of the species live chiefly either in fresh or in salt water, they readily accommodate themselves to a change, and, as far as the European kinds are concerned, all may be met with in the brackish water of certain littoral districts. The majority have a compressed well-proportioned body, which in the marine species is of a more elongate form, leading to the allied group of Flute-Mouths (*Fistulariidae*), which are, in fact, gigantic marine sticklebacks. Their mouth is of moderate width, oblique, and armed with small but firmly set teeth. But their most distinctive characteristic consists in the armature of their head and body. The head is nearly entirely protected by hard bone; even the cheeks, which in the majority of fishes are covered with a naked or scaly skin, are in this genus cuirassed by the dilated infraorbital bones. There are no scales developed on any part of the body, but a series of hard and large scutes protects a greater or lesser portion of the sides. The first dorsal fin and the ventrals are transformed into pointed formidable spines, and joined to firm bony plates of the endoskeleton. With regard to the degree in which this armature is developed, not only do the species differ from each other, but almost every species shows an extraordinary amount of variation, so that some older naturalists have distinguished a multitude of species, whilst the majority of the present day are inclined to reduce their number considerably. About ten kinds may be taken to be specifically distinct.

So far as is known at present, all sticklebacks construct a nest for the reception of the spawn, which is jealously guarded by the male until the young are hatched, which event takes place in from ten to eighteen days after oviposition. He also protects them for the first few days of their existence, and provides them with food, until they gradually stray from their home. The construction of the nest varies in the different species.

Sticklebacks are short-lived animals; they are said to reach an age of only three or four years; yet their short life, at least that of the males, is full of excitement. During the first year of their existence, before the breeding-season begins, they live in small companies in still pools or gently flowing brooks. But with the return of the warmer season each male selects a territory, which he fiercely defends against all comers, especially against intruders of his own species and sex, and to which he invites all females, until the nest is filled with ova. At this period he also assumes a bridal dress, painted with blue and red tints. The eggs are of comparatively large size, one female depositing only from 50 to 100; but, as the females deposit their spawn in nests of different males, the number of ova contained in one nest does not exceed one hundred.

Of the species known not one has so wide a geographical range, and has so well been studied, as the common British Three-Spined Stickleback (*Gastrosteus aculeatus*). It is found everywhere in northern and central Europe, northern Asia, and North America. The development of its scutes and spines varies exceedingly, and specimens may be found without any lateral scutes and with short spines, others with only a few scutes and moderately sized spines,

and again others which possess a complete row of scutes from the head to the caudal fin, and in which the fin-spines are twice as long and strong as in other varieties. On the whole, the smooth varieties are more numerous in southern than in northern localities. This species swarms in some years in prodigious num-



Gastrosteus aculeatus, var. *noveboracensis*, Three-Spined Stickleback.

bers; in Pennant's time amazing shoals appeared in the fens of Lincolnshire every seven or eight years. Their numbers may perhaps be conceived from the fact that a man employed in collecting them gained, for a considerable time, four shillings a day by selling them at the rate of a halfpenny a bushel. No instance of a similar increase of this fish has been observed in our time, and this possibly may be due to the diminished number of suitable breeding-places in consequence of the general introduction of artificial drainage. This species usually constructs its nest on the bottom, excavating a hollow in which a bed of grass, rootlets, or fibres is prepared; walls are then raised, and the whole is roofed over with the like material. The nest is an inch and more in diameter, with a small aperture for an entrance.

The Ten-Spined Stickleback (*Gastrosteus pungitius*) is so called from the number of spines usually composing its first dorsal fin, which, however, may be sometimes reduced to eight or nine or increased to eleven. It is smaller than the three-spined species, rarely exceeding 2 inches in length. Its geographical range nearly coincides with that of the other species, but it is more locally distributed, and its range in northern Asia is not known. With regard to its habits, it differs from the common species only in the selection of the site for its nest, which is generally placed among weeds above the bottom of the water. Breeding males are readily recognized at a distance by the intensely black colour of the lower parts of their body.

Both these species are for their size extremely voracious, causing no small amount of injury if allowed in breeding-ponds in which valuable fish are preserved. During the whole time they are not engaged in their breeding operations they are in pursuit of food. A small stickleback kept in an aquarium devoured, in five hours' time, seventy-four newly-hatched dace, which were about a quarter of an inch long. Two days after it swallowed sixty-two, and would probably have eaten as many every day, could they have been procured.

The Sea Stickleback (*Gastrosteus spinachia*) is a much larger and more slender species than those mentioned; it attains to a length of 7 inches, and is armed with fifteen short spines on the back. It is extremely common round the British coasts, but never congregates in large shoals. At suitable localities of the coast which are sheltered from the waves and overgrown with sea-weed, especially in rock-pools, one or two males establish themselves with their harems, and may be observed without difficulty, being quite as fearless as their freshwater cousins. Harbours and shallows covered with *Zostera* are likewise favourite haunts of this species, although the water may be brackish. The nest is always firmly attached to sea-weed, and sometimes suspended from an overhanging frond. This species inhabits only the northern coasts of Europe.

STIGMATIZATION, literally the infliction of *stigmata*, i.e., marks tattooed or branded on the person, the term used with specific reference to the infliction of wounds like those of Christ.

An ancient and widespread method of showing tribal connexion, or relation to tribal deities, is by marks set upon the person; thus Herodotus, in describing a temple of Hercules in Egypt (ii. 113), says that it is not lawful to capture runaway slaves who take refuge therein if they receive certain marks on their bodies, devoting them to the deity. Some such idea is perhaps alluded to by Paul (Gal. vi. 17) in the words, "from henceforth let no man trouble me, for I bear branded on my body the stigmata of Jesus"; and some few authors have even understood the passage as referring to stigmatization in the modern sense (Molanus, *De Historia SS. Imaginum et Picturarum*, ed. Paquet, iii. 43, p. 365). Branding, as indicative of servi-

tude, is mentioned in many of the classics (Pliny, *H. N.*, xviii. 3; Varro, *De Re Rustica*, i. 18; Suetonius, *Caligula*, xxvii. &c.), and was forbidden by Constantine.

In the period of persecution Christian martyrs were sometimes branded with the name of Christ on their foreheads (Pontius, "De Vit. S. Cypriani," *Biblioth. Veterum Patrum*, iii. p. 472, § vii.). This was sometimes self-inflicted as a disfigurement by nuns for their protection, as in the case of St Ebba, abbess of Coldingham (see Baronius, *Annales*, xv. p. 215, anno 870, also Tert., *De Vel. Virg.*). Some Christians likewise marked themselves on their hands or arms with the cross or the name of Christ (Procopius, *In Esaiam*, ed. Curterius, p. 496), and other voluntary mutilations for Christ's sake are mentioned (Matt. xix. 12; Fortunatus, *Life of St Rhadegund*, ed. Migne, col. 508; Palladius, *Lausiac History*, cxii.; Jerome's *Letter to St Eustochium*, &c.).

In the life of St Francis of Assisi we have the first example of the alleged miraculous infliction of stigmata (see vol. ix. p. 692). While meditating on the sufferings of our Lord, in his cell on Mount Alverno, we are told by his biographers, Thomas of Celano and Bonaventura, that the Lord appeared to him as a seraph and produced upon his body the five wounds of Christ; of these we are told that the side wound bled occasionally, though Bonaventura calls it a scar, and the wounds in the feet had the appearance and colour of nails thrust through. After his death St Clare endeavoured but in vain to extract one of these. Pope Alexander IV. and other witnesses declared that they had seen these marks both before and after his death (Raynaldus, ad annum 1255, p. 27). The divinely-attested sanctity of their founder gave to the newly-established order of Franciscans a powerful impulse, so that they soon equalled and threatened to overshadow in influence the previously-founded order of St Dominic.

The reputation of the latter order was, however, equally raised in the next century by the occurrence of the same wonder in the case of a sister of the third rule of St Dominic, Catherine Benincasa,—better known as St Catherine of Siena. From her biographer's account we gather that she was subject to hystero-epileptic attacks, in one of which, when she was twenty-three years old, she received the first stigma (see vol. v. p. 30). In spite of her great reputation, and the number of attesting witnesses, this occurrence was not universally believed in. Pope Sixtus IV. published a bull in 1475 ordering, on pain of anathema, the erasure of stigmata from pictures of St Catherine, and prohibiting all expressions of belief in the occurrence. Pope Innocent VIII. similarly legislated "ne de cetero S. Catherina cum stigmatibus depingatur; neve de ejus stigmatibus fiat verbum, aut sermo, vel prædicatio ad tollendam omnem scandali occasionem" (see references in Raynaud, *De Stigmatisme*, cap. xi., 1665). In the years which followed, cases of stigmatization occurred thick and fast,—now a Franciscan, now a Dominican, very rarely a religieuse of another order, showing the marks. Altogether about ninety instances are on record, of which eighteen were males and seventy-two females. Most of them occurred among residents in religious houses, and took place after the austerities of Lent, usually on Good Friday, when the mind was intently fixed on our Lord's Passion; and, from their occurrence being for the most part among members of the two orders to which St Francis and St Catherine belonged, the possibility of the reception of the marks was constantly before their eyes and thoughts. The order of infliction in the majority of cases was that of the crucifixion, the first token being a bloody sweat, followed by the coronation with thorns; afterwards the hand and foot wounds appear; that of the side being the last. The grade of the infliction varied in

individual cases, and they may be grouped in the following series:—

I. As regards full stigmatization, with the visible production of the five wounds, and generally with the mark of the crown as well, the oldest case, after St Francis, is that of Ida of Louvain (1300), in whom the marks appeared as coloured circles; in Gertrude von Oosten of Delft (1344) they were coloured scars, and disappeared in answer to prayer as they also did on Dominica de Paradis; in Sister Pierona, a Franciscan, they were blackish grey. They were true wounds in Margaret Ebnerin of Nuremberg (d. 1351), but they also disappeared in answer to her prayer (see her *Life*, Augsburg, 1717), as was the case with Brigitta, a Dominican tertiary (1390), and also with Lidwina. An intermission is described in the marks on Johanna della Croce of Madrid (1524), in whom the wound in the side was large, and the others were rose-coloured circular patches. The marks appeared on each Friday and vanished on Sunday. These emitted an odour of violets; but in Sister Apollonia of Volaterra they were fetid while she lived. Angela della Pace (1634) was fully stigmatized at nine years of age, being even marked with the sponge and hyssop on the mouth; while Joanna de Jesu-Maria at Burgos (1613), a widow, who had entered the convent of Poor Clares, was marked in her sixtieth year. To her in vision two crowns were offered,—one of flowers and one of thorns; she chose the latter and immediately was seized with such pain that her confessor heard her skull cracking. This case was investigated by the officers of the Inquisition. The stigmatization of Veronica Giuliani (1696) was also the subject of inquiry, and in this case the nun drew on a paper a representation of the images which she said were engraved on her heart. On a post-mortem examination being made in 1727 by Prof. Gentili and Dr Bordiga, the image of the cross, the scourge, &c., were said to have been impressed on the right side of the organ (*Vita della Veronica Giuliani*, by Salvatori, Rome, 1803). The case of Christina Stambelen, a Dominican at Cologne, is noteworthy, as on her skull there was found a raised ridge or crown which was at first green, with red dots. This relic is still preserved. In Lucia di Narni (1546) the marks were variable, as they also were on Sister Maria di S. Dominico. On the body of St Margaret of Hungary the stigmata were found fresh and clear when her body was exhumed some time after her death for transportation to Presburg. Other stigmatized persons were Elizabeth von Spalbeck, a Cistercian; Sister Coleta, a Poor Clare; Matilda von Stanz; Margaret Bruch of Enderingen (1503); Maria Razzi of Chios (1582); Catharina Januensis; Elizabeth Reith of Allgau; Stieva zu Hamm in Westphalia; Sister Mary of the Incarnation at Pontoise; Archangela Tardera in Sicily (1608); Catharina Ricci in Florence (1590); and Joanna Maria della Croce, a Poor Clare at Roveredo (d. 1673), upon whom the markings of the thorn crown and spear wound were especially deep.

II. In some cases, although the pains of stigmatization were felt, there were no marks apparent. This occurred to Helen Brunsen (1285); Helena of Hungary (1270); Osanna of Mantua (1476); Columba Rocessani; Magdalena de Pazzis; Anna of Vargas; Hieronyma Carvaglio; Maria of Lisbon, a Dominican; Joanna di Vernyma Carvaglio; Maria of Lisbon, a Dominican; Sister Christina, a Carcellian; Stephania Soncinas, a Franciscan; Sister Christina, a Carcellian; and Joanna Rodriguez, a Poor Clare. In the case of Ursula Aguir de Valenza, a tertiary of St Dominic (1608), and Catharina Cialina (d. 1619) the pain was chiefly that of the crown of thorns, as it was also in Amelia Bicchieri of Vercelli, an Augustinian.

III. In a third series some of the marks were visible on the body, while others were absent or only subjectively indicated by severe pains. The crown of thorns only was marked on the head of Vincentia Ferreria at Valencia (d. 1515) and Philippa de Santo Tomaso of Montemor (1670), while according to Torellus the Augustinian Ritta von Cassla (d. 1430) had a single thorn wound on the forehead. The crown was marked on Catharina of Raconizio (b. 1486), who also suffered a severe bloody sweat. In the case of Stephano Quinzani, in Soncino (1457), there was a profuse bloody sweat and the wounds were intermitting, appearing on Friday and Saturday, vanishing on Sunday. Blanche Gazinan, daughter of Count Arias de Sagavedra (1564), was marked only on the right foot, as also was Catherine, a Cistercian nun. The heart wound was visible in Christina Mirabilis (1232). Gabriella de Piezolo (d. 1473) died from the bleeding of such a wound, and similar wounds were described in Maria de Acostrin in Toledo; Eustochia, a tertiary of St Francis; Clara de Bugny, a Dominican (1514); Cecilia Nobili, a Poor Clare of Nuceria (d. 1655). In the last instance the heart wound was found after death—a three-cornered puncture. A similar wound was seen in the heart of Martina de Arilla (d. 1644). Maria Villana, a Poor Clare, daughter of the margrave of La Pella, was marked with the crown and spear, and thrust, and after death the impresses of the spear, sponge, and reed were found on her heart (d. 1670). The wound was usually on the left side, as in Sister Masrona of Grenoble, a tertiary of St Francis (1627); it was on the right in Margareta Columa, also a Poor Clare. In Maria de Sarmiento it was said to have been inflicted by a seraph in a vision.