the Seine and the Channel, but deep valleys have been hollowed out by the streams. The Bray district in the south-east is a broad valley of denudation formed by the sea as it retired, and it is traversed by smaller valleys and covered with excellent pasture. In the comparatively regular outline of the coast there are a few breaks, as at Tréport, Dieppe, St Valery-en-Caux, Fécamp, and Havre, the Cap de la Hève, which commands this last port, and Cape Antifer, 12 or 13 miles farther north. Tréport, Dieppe, Veules, St Valery, Fécamp, Yport, Etretat, and Ste Adresse (to mention only the more important) are fashionable watering-places with the Parisians. The winters are not quite so cold nor is the summer so hot as in Paris, and the average temperature of the year is higher. The rainfall is 24 inches per annum, increasing from Rouen to Dieppe as the sea is approached.

With a total area of 1,491,458 acres, Seine Inférieure has 911,938 acres of arable ground, 151,125 of wood, 99,703 grass, 32,977 moorland and pasturage. Out of a total population of 814,068 in 1881 those dependent on agriculture numbered 233,536. The live stock in the same year comprised 81,561 horses of good breeds, 1421 asses, 125 mules, 236,493 cattle, 259,677 sheep of ordinary kinds and 27,523 of special breeds (wool-clip, 560 tons), 78,186 pigs, 3341 goats, 13,202 beehives (54 tons of honey and 13 of wax). Milch cows are kept in great numbers, and Gournay butter and Gournay and Neufchâtel cheese are in repute. The farms of the Caux plateau are each surrounded by an earthen dyke, on which are planted forest trees, generally beech and oak. Within the shelter thus provided apple and pear trees grow, which produce the cider generally drunk by the inhabitants (38,602,036 gallons in 1883). The other crops in 1883 were—wheat, 6,667,650 bushels; meslin, 59,950; rye, 654,489; barley, 443,751; oats, 7,017,609; potatoes, 2,954,457; pulse, 98,736; beetroot for sugar 28,837 tons, and for fodder 118,099; colza seed, 29,076 tons; and 457,047 tons of ordinary fodder. In general the department is fertile and well cultivated. Along the Seine fine meadow-land has been reclaimed by dyking; and sandy and barren districts have been planted with trees, mostly with oaks and beeches, and they often attain magnificent dimensions, especially in the forest of Arques and along the railway from Rouen to Dieppe; *Pinus sylvestris* is the principal component of the forest of Rouvray opposite Rouen. With the exception of a little peat and a number of quarries, employing 745 workmen, Seine Inférieure has no mineral source of wealth; but manufacturing industry is well developed. Rouen is the chief centre of the cotton-trade, which is in the department represented by 190 spinning and weaving factories, employing 22,947 hands, 1,400,000 spindles, 14,000 power-looms, and 4000 hand-looms, and working up 30,000 tons of cotton annually. Hand-loom weaving, carried on throughout the country districts, employs 18,000 looms; in the branch of the cotton trade known as *rouennerie* 190 manufacturers are employed, producing to the value of £2,400,000 per annum; in that of the *indiennes* 20 establishments with 5000 workpeople turn out yearly 1,000,000 pieces of 115 yards each. There are 22 establishments for dyeing cotton cloth with 700 workmen, and for dyeing cotton yarn 32 establishments with 1200 workmen. The woollen manufacture, of which Elbeuf is the centre, employs 24,000 workmen and produces goods valued at about £3,500,000, with raw material valued at £1,720,000, mainly imported from Australia and partly from the La Plata ports. The wool-spinning mills (at Elbeuf and Darnétal) have 92,000 spindles, and there are 650 power-looms and 3800 hand-looms. At Elbeuf (22,883 inhabitants in 1881) there are 17 dyeworks, 50 twist factories, a manufactory of carding machines, and 45 cloth-dressing factories. About 18,000 spindles are employed in flax-spinning, an industry more widely distributed throughout the department. Engineering works, foundries, and iron shipbuilding yards occur at Havre (population 105,540 in 1881) and Rouen (105,860). Wooden ships are also built at Havre, Rouen, Dieppe (21,585), and Fécamp (11,919). Other establishments of importance are the national tobacco-factories at Dieppe (1100 hands) and Havre (580 hands), sugar-refineries (£1,440,000 worth of sugar in 1881), glass-works (873 workmen), soap-works, chemical works, candle-factories, flour-mills, oil-factories, ivory-works, lace-works, clock-factories, &c. The total number of industrial establishments in the department is 975; and it is estimated that 305,460 persons depend on industrial pursuits. The fisheries are a great resource for the inhabitants of the seaboard. Fécamp sends yearly £100 000 worth of cod and £80,000 worth of herrings, mackerel, &c., into the market; Dieppe has the supplying of Paris with fresh fish; St Valery sends its boats as far as Iceland. The principal ports for foreign trade are Havre, Rouen, and Dieppe. There are 364 miles of railway, 370 of national roads, 6543 of other roads, 98 of Seine navigation, and the Bresle is canalized for 2 miles. In population Seine Inférieure stands fourth in the list of French departments; it has consequently been proposed to divide it into the two departments of Seine Inferieure and Seine Maritime. The density of population is double the average of France. There are 5 arrondissements, 51 cantons (of which 3 are in Havre and 6 in Rouen), and 759 communes. The department forms the archbishopric of Rouen; the court of appeal and the headquarters of the *corps d'armée* are also in that city. Places of importance are Elbeuf; Fécamp, a fishing port, with sea-bathing, distilling, &c.; Bolbec (10,226 inhabitants), with weaving and spinning factories; and Eu (4827 inhabitants), with a celebrated castle belonging to Louis Philippe and the Orleans family.

SEISIN. "Seisin of the freehold may be defined to be the possession of such an estate in land as was anciently thought worthy to be held by a free man" (Williams, *On Seisin*, p. 2). Seisin is now confined to possession of the freehold, though at one time it appears to have been used for simple possession without regard to the estate of the possessor. (See POSSESSION.) Its importance is considerably less than it was at one time owing to the old form of conveyance by feoffment with livery of seisin having been superseded by a deed of grant (see REAL ESTATE), and the old rule of descent from the person last seised having been abolished in favour of descent from the purchaser. (See INHERITANCE.) At one time the right of the wife to dower and of the husband to an estate by curtesy depended upon the doctrine of seisin. The Dower Act, 3 and 4 Will. IV. c. 105, has, however, rendered the fact of the seisin of the husband of no importance, and the Married Women's Property Act, 1882, appears to have practically abolished the old law of curtesy. In the case of a conveyance operating under the Statute of Uses, seisin is deemed to be given by the effect of the statute. This constructive seisin may still be of importance where the question arises how long a person has been in actual possession. Thus in *Orme's Case* (Law Rep., 8 Common Pleas, 281) the right to a county vote depended upon the form of the conveyance of a rent-charge to the voter. If the conveyance had been under the statute, the claimant would have been seised for a sufficient time; the court, however, held that the conveyance was a common law grant, and that the grantee must have been in actual receipt of the rent in order to entitle him to be registered.

Primer seisin was a feudal burden at one time incident to the king's tenants *in capite*, whether by knight service or in socage. It was the right of the crown to receive of the heir, after the death of a tenant *in capite*, one year's profits of lands in possession and half a year's profits of lands in reversion. The right was abandoned by the Act abolishing feudal tenures (12 Car. II. c. 24).

In Scotch law the corresponding term is "sasine." Like seisin in England, sasine has become of little legal importance owing to recent legislation. By 8 and 9 Vict. c. 35 actual sasine on the lands was made unnecessary. By 21 and 22 Vict. c. 76 the instrument of sasine was superseded by the recording of the conveyance with a warrant of registration thereon. For the register of sasines, see REGISTRATION.

SEISMOMETER. This name was originally given to instruments designed to measure the movement of the ground during earthquakes. Recent observations have shown that, in addition to the comparatively great and sudden displacements which occur in earthquakes, the ground is subject to other movements. Some of these, which may be called "earth-tremors," resemble earthquakes in the rapidity with which they occur, but differ from earthquakes in being imperceptible (owing to the smallness of the motion) until instrumental means are used to detect them. Others, which may be called "earth-tiltings," show themselves by a slow bending and unbending of the surface, so that a post stuck in the ground, vertical to begin with, does not remain vertical, but inclines now to one side and now to another, the plane of the ground in which it stands shifting relatively to the horizon. No sharp distinction can be drawn between these classes

of movements. Earthquakes and earth tremors grade into one another, and in almost every earthquake there is some tilting of the surface. The term "seismometer" may conveniently be extended (and will here be understood) to cover all instruments which are designed to measure movements of the ground.

Measurements of earth-movements are of two distinct types. In one type, which is applicable to ordinary earthquakes and earth-tremors, the thing measured is the displacement of a point in the earth's crust. In the second type, which is applicable to slow tiltings, the thing measured is any change in the plane of the earth's surface relatively to the vertical. Under EARTHQUAKE mention is made of instruments designed by Palmieri and others to register the occurrence of earthquakes, and in some cases to give a general idea of their severity. While some of those instruments act well as seismoscopes, none of them serve to determine with precision the character or the magnitude of the motion. In this article notice will be taken only of instruments intended for exact measurement.

Earthquake displacements are in general vertical as well as horizontal. For the purpose of measurement it is convenient to treat the vertical component separately, and in some cases to resolve the horizontal motion into two components at right angles to each other.

Inertia Method.—In the first type of measurements what may be called the "inertia" method is followed. A mass is suspended with freedom to move in the direction of that component of the earth's motion which is to be measured. When an impulse occurs the supports move, but the mass is prevented by its inertia from accompanying them. It supplies a steady point, to be used as a standard of reference in determining the extent through which the ground has moved in the direction in question. But, in order that the suspended mass shall not acquire motion when its supports move, one essential condition must be satisfied. Its equilibrium must be neutral, or nearly so, in order that, when the supports are displaced, little or no force may be brought into operation tending to bring the mass into the same position relative to the supports as it occupied before disturbance. This can be made plain by considering the case of a common pendulum hung from a support which is rigidly fixed to the ground. When the ground moves in any horizontal direction the pendulum's inertia causes a certain point in it (the centre of percussion) to remain for the instant at rest. But this contrivance does not yield a steady point, because the stability of the pendulum makes the bob swing down to recover its place directly under the support; and in fact, if a succession of oscillations of the ground occur, the bob acquires a motion often much greater than the motion of the support itself. This tendency may be corrected, and the pendulum made fit to act as a seismometer, by any contrivance which (without introducing friction) will reduce its stability so much as to make the equilibrium of the bob very nearly neutral. In all instruments designed to furnish a steady point the suspended mass must have some small stability,

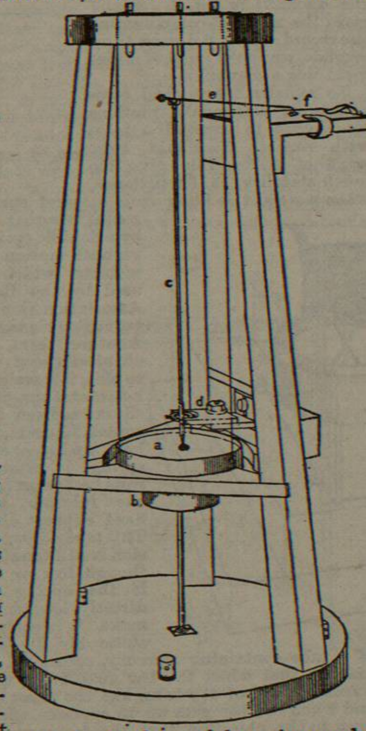


FIG. 1.—Duplex pendulum seismograph.

else it would be unmanageable; but its period of free oscillation must be much greater than that of the earthquake-motions which it is employed to measure. Even a simple pendulum can have its stability reduced sufficiently to fit it for seismometric work by making it very long. The same result is, however, much more conveniently achieved by combining a common pendulum with an inverted pendulum placed just beneath it. The common pendulum being stable and the inverted pendulum unstable, if the bobs are jointed so that they must move together, the combination can be made as nearly astatic as may be desired.[1] Figs. 1 and 2 illustrate how this combination is applied in seismometry. The stable bob *a*, hung from a fixed support above by three parallel wires, is connected with the inverted pendulum *b* by a ball-and-tube joint. A lever *c*, carried by a gimbal joint in the fixed bracket *d*, is geared also by a ball-and-tube joint to the upper bob. Its long arm carries a jointed index *e*, which projects out and touches a smoked-glass plate *f*, held on a fixed shelf. Any horizontal motion of the ground acts on the lever by the bracket *d*, and causes the index to trace a magnified record on the smoked-glass plate. Fig. 1 is taken from a photograph of an instrument of this kind, constructed to give a much magnified record of small movements. When large earthquakes are to be recorded the multiplying lever is dispensed with, and the index is attached directly to one of the bobs. Observations with instruments of this class exhibit well the very complicated motion which the earth's surface undergoes during an earthquake. In small earthquakes (such as are only slightly or not at all destructive) the greatest amplitude of motion is often less than a millimetre, and rarely more than a centimetre; the disturbance nevertheless consists of a multitude of successive movements, quite irregular in amplitude, period, and direction. Fig. 3 is a facsimile of the record given by a duplex pendulum seismograph during one of the earthquakes which occur frequently in the plain of Yedo, Japan. The record, as engraved, is three and a half times the earth's actual motion. Instead of two pendulums, a single inverted pendulum has been used, with a spring stretched between it and a fixed support above. By adjusting the spring so that a proper proportion of the weight is borne by it and the remainder by the rigid stem of the pendulum, an approach to neutral equilibrium can be made.[2] In Forbes's inverted pendulum seismometer[3] a somewhat similar plan was adopted: the foot of the pendulum was attached to an elastic wire which tended to restore it to its normal vertical position when displaced.

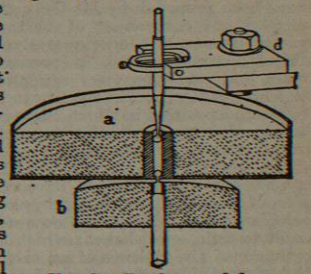


FIG. 2.—Duplex pendulum showing details.

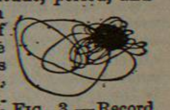


FIG. 3.—Record of earthquake motion.

Another group of instruments designed to furnish two degrees of freedom for the purpose of recording all motions in a horizontal plane, but much less satisfactory on account of their friction, is that in which a rolling sphere either itself supplies inertia or forms a support for a second inertia-giving mass. Probably the earliest was one used in Japan by Dr G. F. Verbeck in 1876 (see fig. 4). On a marble table, ground plane and carefully levelled, four balls of rock-crystal were placed, carrying a massive block of hard wood. A pencil, sliding in a hole in the block, registered the relative motion of the table and the block on a sheet of paper fixed below. The motion registered is (or would be, if there were no friction) somewhat larger than the true motion of the table, for the system is kinetically equivalent to four upright pieces whose centres of percussion lie in a plane nearly, but not quite, as high as the tops of the balls. This forms what may be called the steady plane; its position depends on the relative masses of block and balls, and is easily calculated. When the ground moves in any direction the block moves through a short distance in the opposite direction, and the record is magnified in a fixed ratio. Various forms of rolling-sphere seismometers have been

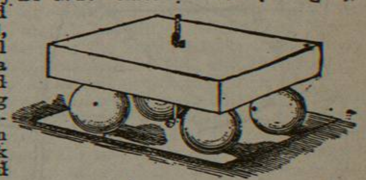


FIG. 4.—Rolling sphere seismograph.

[1] J. A. Ewing, "A Duplex Pendulum Seismometer," in *Transactions of the Seismological Society of Japan*, vol. v., 1882, p. 89.

[2] Ewing, "A Duplex Pendulum with a Single Bob," in *Trans. Seis. Soc. Jap.*, vol. vi., 1883, p. 19.

[3] *Report of Brit. Assoc.*, 1841, p. 47, or *Trans. R. S. E.*, xv. p. 219.

proposed by Mr. T. Gray,[1] Mr. C. A. Stevenson,[2] and others. Probably the best form would be that of a light spherical segment rolling on a level plane base and carrying a heavy bob fixed to it. To give some stability the bob should be placed so as to bring the centre of gravity a little under the centre of curvature. The centre of percussion, somewhat higher than this, would of course be the steady point, and a multiplying pointer might take the motion either from it or from any other convenient part of the rolling piece. All rolling seismometers—including rolling cylinders, which have been proposed by Mr Gray as single-freedom instruments, to register one component of horizontal motion—fail to act well, partly because of the comparatively great frictional or quasi-frictional resistance which is presented to the motion of the free mass, and partly because, owing to imperfections in the construction and want of perfect rigidity in the materials, the ball or cylinder takes up a position in which there is an objectionably great stability as regards very small displacements. These objections make the use of rolling seismometers unadvisable, except perhaps for the rough measurement of violent earthquakes.

The seismographs which have been described draw a horizontal plan of the path pursued during an earthquake by a point on the earth's surface. They take no note of the relation of the displacement to time,—an element which is required if we are to form any estimate of the violence of an earthquake from the record. With this view a different method of registration is also followed. The whole movement is resolved into rectilinear components, and these are separately recorded (by single-freedom seismometers) on a plate or drum which is kept in continuous movement, so that the record of each component takes the form of an undulating line, from which the number, succession, amplitude, velocity, and acceleration of the component movements can be deduced and the resultant motion determined. A single steady mass with two degrees of freedom may still be employed to record, separately, two components of horizontal motion; but it is generally preferable to provide two distinct masses, each with one degree of freedom. The principal instrument of this class is the horizontal pendulum seismograph,[3] which has been used to record Japanese earthquakes since 1880. It consists of two horizontal pendulums, set at right angles to each other, each supplying a steady point with respect to horizontal motions transverse to its own length. Each pendulum is pivoted about two points, on an axis which is nearly vertical, but inclined slightly forwards to give a suitable degree of stability. In some forms of the instrument the pivoted frame of the pendulum is light, and the inertia is practically all furnished by a second piece or bob pivoted on the frame about a vertical axis through the centre of percussion of the frame. This construction has the advantage of compactness and of making the position of the steady point at once determinate. But a simpler construction is to attach the bob rigidly to the frame. This shifts the steady point a little way outwards from the position it would have if the bob were pivoted. In either construction a prolongation of the pendulum beyond the bob forms a convenient multiplying index. Fig.

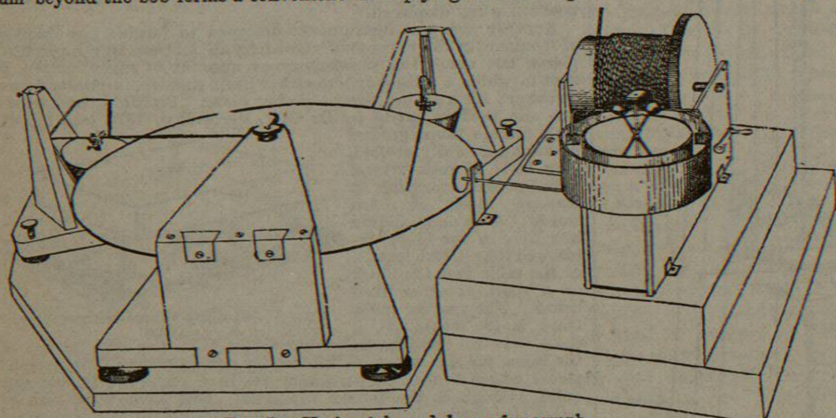


FIG. 5.—Horizontal pendulum seismograph.

5 shows a complete horizontal pendulum seismograph (with pivoted bobs). Two rectangular components of earthquake motion are recorded radially on a revolving plate of smoked glass, which receives its motion through a friction roller from a clock furnished with a fluid-friction centrifugal governor. The clock may either be kept going continuously, in expectation of an earthquake at any moment, or be started into motion by an electric seismoscope when the earliest indications of an earthquake are felt. The former plan is practicable only when the instrument can receive careful attendance and where earthquakes occur often. It has the drawback that the circle which is drawn by each pointer as the plate revolves below it gradually broadens, partly because of warping and temperature changes in the supports and partly because of actual tilting of the ground. As an earthquake generally begins with comparatively insignificant movements, there is not much to object to in having the plate at rest to begin with, provided a sufficiently sensitive starting seismoscope be used. A suitable arrangement for this purpose is one due to Palmieri: a short pendulum hangs over a cup of mercury, in the centre of which a depression is formed by an iron pin, whose top is a little lower than the surface of the mercury. The pendulum ends in a platinum point, which stands clear in the centre of this depression, but touches the edge whenever a horizontal movement of the ground takes place, thereby closing the circuit of an electro-magnet, which starts the clock. In the most recent form of the horizontal pendulum seismograph the bobs are fixed to the pivoted frames, and the pointers are arranged to trace their records side by side. Records with instruments of this class, besides giving much additional information, agree with those of the duplex pendulum in showing that earthquake motion is a tangle of waves in all azimuths. This will be seen by reference to fig. 6, which shows a small portion of an earthquake registered by a pair of horizontal pendulums. Contemporary parts of the two records are shown together, the straight radial lines marking seconds of time. The phases of the two components are continually changing, and when the two are compounded the result is a path having the same characteristics as those of the diagram in fig. 3. Fig. 7 gives the result of compounding the records of fig. 6 during three seconds, while the range of movement was a maximum.

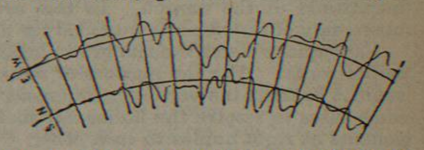


FIG. 6.—Record of earthquake by horizontal pendulum seismograph; one-third full size.

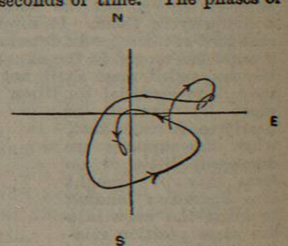


FIG. 7.—Result of compounding the record of fig. 6.

To register the vertical component of earthquake motions we require to suspend a mass with vertical freedom. Most ways of doing this give too much stability, as, for instance, when a weight is hung from a spiral spring or carried by a horizontal bar that is fixed to a wall or table by a flexible spring joint. This last is the vertical motion seismometer which was used by the British Association Committee at Comrie in 1842. Another form, mechanically equivalent to this, is a weighted horizontal bar, pivoted on a fixed horizontal fulcrum, and held up by a spiral spring, stretched from a point near the fulcrum to a fixed support above. This mode of suspension is still too stable, though less so than if the spring were directly loaded. To make it nearly astatic Mr T. Gray[4] proposed the use of a tube containing mercury, connected with the bar in such a manner that when the bar goes down the mercury, running towards one end of the tube, has the effect of increasing the weight, and when the bar goes up an opposite effect occurs. This plan is open to the objection that the mercury is disturbed by horizontal movements of the ground. A simpler plan is shown in fig. 8.[5] There the pull of the spring is applied at a short distance v below the plane of the bar. Hence when the weight goes down the spring,

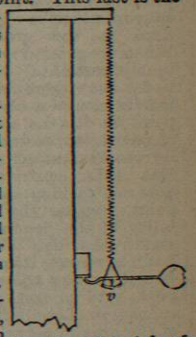


FIG. 8.—Principle of vertical motion seismograph.

1 Gray, *Phil. Mag.*, September 1881.
2 Stevenson, *Trans. Roy. Scot. Soc. of Arts*, February 1882.
3 Ewing, "On a New Seismograph," in *Proc. Roy. Soc.*, No. 210, 1881, or *Trans. Seis. Soc. of Japan*, December 1880.
4 Gray, *Trans. Seis. Soc. Jap.*, vol. iii. p. 137.
5 Ewing, *Trans. Seis. Soc. Jap.*, vol. iii. p. 140.

which then pulls with more force, pulls with a smaller leverage, and it is easy to adjust the distance v so that the moment of the pull of the spring remains sensibly equal to the moment of the weight,—the condition necessary to make the bar astatic. This is secured when $v=\frac{h^2}{l}$, h being the horizontal distance from the fulcrum to the point at which the spring acts, and l the length by which the spring is stretched when the bar is undeflected. Stability is given by making v somewhat less than this. A vertical-motion seismograph, constructed on the principle which fig. 8 illustrates diagrammatically, is arranged to trace its record on a revolving glass plate. This, along with a pair of horizontal pendulums recording on the same plate, completes a three-component seismograph.

An interesting mode of suspension, by which a mass is hung in neutral or nearly neutral equilibrium, with one degree of horizontal freedom, is shown in fig. 9. It is based on the approximate straight line linkwork of Tchebicheff. When a bar is hung from fixed supports by crossed ties, at a distance below the supports equal to the distance between the supports, the length of the bar being equal to half that distance, its middle point moves in very nearly a straight line. By fixing a weight at the centre of the bar and adding a suitable recording apparatus, we have a very frictionless form of one-component horizontal seismometer.[1] When a displacement of the ground occurs in the line of the bar, the bar is tilted through an angle which is proportional to the linear displacement, and the centre of the bar consequently shares, in a small and definite proportion, the motion of the ground,—a fact which is to be borne in mind in estimating the degree of multiplication given by the recording apparatus.

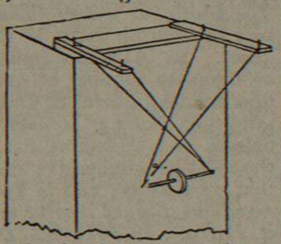


FIG. 9.—Astatic suspension.

The instruments which have been described afford complete and satisfactory means of determining the motion which a point of the ground undergoes during any disturbance which would be recognized as an earthquake. For minute earth-tremors, however, a larger multiplication is necessary, and the absence of friction is of even more importance than in the measurement of earthquakes proper. Optical methods of magnifying the motion are accordingly resorted to. In the "normal tromometer" of Bertelli, used in Italy to detect earth-tremors, the bob of a pendulum, suspended by a fine wire from a fixed support, is viewed through a reflecting prism and its motion in any azimuth measured by a micrometer microscope. The great stability of the pendulum, which is only $1\frac{1}{2}$ metres long, prevents it from behaving as a steady-point seismometer; and, if successive earth-movements were by chance to occur with a period equal or nearly equal to its own free period, its acquired swing would altogether mask the legitimate indications. This kind of action has, in fact, been turned to account as a means of detecting very minute earth-tremors by Rossi, who has devised a micro-seismoscope, consisting of a number of pendulums of various lengths, one or other of which is likely to be set swinging when the ground shakes to and fro repeatedly, through even the minutest range. To *measure* tremors, however, the instruments of Bertelli and Rossi are inappropriate; for that purpose, just as for the purpose of measuring larger motions, the suspended mass must be in nearly neutral equilibrium. To find a mode of suspension which is at once astatic and extremely frictionless is a matter of some difficulty; the crossed-link suspension, which has been already described, is probably the most satisfactory means hitherto suggested. It has been adopted in the micro-seismometer sketched in section in fig. 10. Two bobs are separately suspended, in the manner shown by fig. 9, at right angles to each other, one above the other, in a cast-iron case. A microscope, fixed to the top of the case and furnished with a micrometer eye-piece, is focused on a hair, which is stretched transversely across a vertical tube in the upper bob a. This serves to measure horizontal motion in the plane of the drawing. Motion at right angles to this is shown by the lower bob c (drawn in section), which carries a similar transverse hair. A fixed lens b between the bobs gives an image of the lower hair in the plane of the upper hair, so that both appear crossed in the field of the microscope, thereby allowing both components of horizontal motion to be observed together.

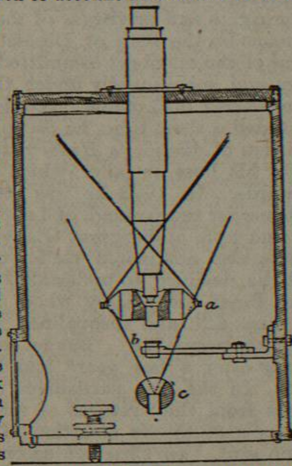


FIG. 10.—Microseismometer.

Equilibrium Method.—In observing slow earth-tiltings an entirely different process is followed. The problem then is, not to measure displacements by aid of the inertia of a body which tends to preserve its original position, but to compare the direction of a line or plane fixed to the earth with the direction of the vertical. The earliest observations of earth-tiltings were made by the aid of spirit-levels. If a level be set on a table fixed to the rock, its bubble, watched through a microscope, will be seen to move slowly now to one side and now to another. The movements are so slow that the inertia of the fluid is unimportant. Observations with pairs of levels, set at right angles to each other, have been carried on systematically for some years by M. P. Plantamour.[2] This is the simplest method of measuring earth-tiltings, but it is liable to errors which are not easily excluded. Another method of investigating changes in the direction of the vertical was initiated in 1868 by M. A. d'Abbadie,[3] who had before that observed the movements of level-bubbles. Light from a fixed source is made to fall on a reflecting basin of mercury about 10 metres below it. Above the basin is a large lens of long focus, which brings the rays into parallelism during their passage to the mercury, and causes them to converge after reflexion, so that an image of the source is formed at a convenient distance from it, and in the same horizontal plane. The interval between the source and the image is measured (in amount and azimuth) at least twice a day by a micrometer microscope. The accuracy of the method depends on the fixity of the source of light relatively to the lens and to the surface of the ground, and to secure this M. d'Abbadie built a massive hollow cone of concrete for the support of his apparatus. His observations have shown that the earth's surface undergoes almost incessant slow tilting through angles which, in the course of a year, have been found to range over four seconds. He has also noticed the occurrence of earth-tremors by the occasional blurring of the image through agitation of the mercury. An improvement on his apparatus suggested by M. Wolf[4] is shown in fig. 11. The light, instead of being all reflected from the free surface of mercury (a), is partly reflected from that and partly from a plane mirror (b) fixed to the rock. Two images are therefore formed, whose relative position measures the tilting of the surface. The advantage of this is that the position of the source of light need no longer be fixed, and the accuracy of the method depends only on the fixity of the mirror b with respect to the rock. Further, to avoid having the source and image at a great height above the surface, M. Wolf allows the light to reach and leave the apparatus horizontally, in the manner indicated in the sketch, by using a plane mirror inclined at 45° to the horizon. Still another mode of investigating slow changes of the vertical was followed (at the suggestion of Sir William Thomson) by Messrs G. H. and H. Darwin, in observations made by them with the view of measuring the lunar disturbance of gravity. The *Reports* of the British Association for 1881 and 1882 contain a full account of their apparatus, as well as notices of the work of other observers and a discussion of the cause of earth-tiltings. Their instrument was a short pendulum hung in a viscous fluid, from a fixed support, by two wires arranged V-wise to leave the pendulum only one degree of freedom. Below the bob was a small mirror hung by two threads, one of which was attached to the pendulum bob and the other to a fixed support. The pendulum was free to swing at right angles to the plane of the threads, and any movement of this kind caused the mirror to rotate through an angle which was measured in the usual way by a telescope and scale. The method is susceptible of very great delicacy, but Messrs Darwin found that when the instrument was adjusted to be specially sensitive its manipulation became extremely difficult. Wolf's modification of D'Abbadie's method appears to furnish, on the whole, the most promising apparatus for measurements of this type. The apparatus represented in fig. 10 is also applicable. The method of measurement employed in the case of slow tiltings may be called the equilibrium method in contradistinction to the inertia method, which is used to measure comparatively sudden displacements. The

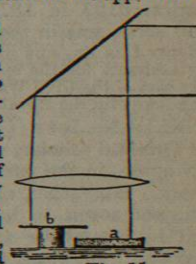


Fig. 11.

1 Ewing, "On certain Methods of Astatic Suspension," in *Trans. Seis. Soc. Jap.*, vol. vi. p. 25.
2 Plantamour, *Comptes Rendus*, 24th June 1878, 1st December 1879, &c.; and numerous papers in *Archives des Sciences*, Geneva, 1878-84.
3 D'Abbadie, *Études sur la Verticale* (Association Française pour l'Avancement des Sciences), 1872, p. 159; also *Ann. de la Soc. Scient. de Bruxelles*, 1881
4 *Comptes Rendus*, xcvii. p. 228.

two methods are applicable to two widely different classes of movements. It is at least possible that between these classes there may be other modes of motion,—displacements which are too slow for the inertia method, and which give rise to too little change of slope for the equilibrium method. How to measure them is, and must apparently remain, an unsolved problem in seismometry.

References.—The *Report* of the British Association for 1858 contains an account by Mallet of some of the older and now obsolete forms of seismometers (see also EARTHQUAKE). For accounts of modern instruments of the inertia class, see the *Transactions of the Seismological Society of Japan* from 1880, also Prof. Ewing's *Memoir on Earthquake Measurement*, published by the university of Tokio (1883). References to papers on the equilibrium method of measurement have been made in the text. (J. A. E.)

SEISTAN See SISTAN.

SEJANUS, ÆLIUS (executed 31 A.D.), the famous minister of TIBERIUS (*q.v.*).

SELBY, a market town of the West Riding of Yorkshire, England, is situated on the navigable river Ouse and on the main line of the Great Northern Railway, 15 miles south of York and 20 east of Leeds. Of the ancient abbey for Benedictines, founded by William the Conqueror in 1069 and raised to the dignity of a mitred abbey by Pope Alexander II., there still remains the church of St Mary and St German, although it has been much changed by alterations and additions, the more ancient and notable features being the nave, transept, and west front. The church was made parochial in 1618. In the market-place there is a modern Gothic market cross. Among the public buildings are the drill hall and the mechanics' institute and public rooms. Flax-scutching, seed-crushing, brick and tile making, boat-building, tanning, and brewing are the principal industries. There is a large trade in potatoes, flax, and mustard, and a considerable cattle-market. The town receives its water-supply from artesian wells. A local board of health was established in 1851, consisting of nine members. The population of the urban sanitary district (6193 in 1871), extended in 1881 from 514 to 3760 acres, was in that year 6057.

Henry I. of England was born in the abbey, a fact which probably accounts for the special privileges conferred on it. In the early part of the Civil War it was held by the Parliament, and after being taken by the Royalists was recaptured by Fairfax.

SELDEN, JOHN (1584-1654), jurist, legal antiquary, and Oriental scholar, was born on 16th December 1584 at Salvington, in the parish of West Tarring, near Worthing, Sussex. His father, also named John Selden, held a small farm, and seems to have occasionally added to his livelihood by his labour as a wheelwright and his skill as a musician. It is said that his accomplishments as a violin-player gained him his wife, whose social position was somewhat superior to his own. She was Margaret, the only child of Thomas Baker of Rustington, a village in the vicinity of West Tarring, and was more or less remotely descended from a knightly family of the same name in Kent. John Selden commenced his education at the free grammar-school at Chichester, whence he proceeded in his sixteenth year with an exhibition to Hart Hall at Oxford. In 1603 he was admitted a member of Clifford's Inn, London, and in 1604 migrated to the Inner Temple, and in due course he was called to the bar. While still a student he appears to have been on terms of friendship with Ben Jonson, Drayton, and Camden; and among his more intimate companions were Edward Littleton, afterwards lord keeper; Henry Rolle, afterwards lord chief-justice; Edward Herbert, afterwards solicitor-general; and Thomas Gardener, afterwards recorder of London. His earliest patron was Sir Robert Cotton, the antiquary, by whom he seems to have been employed in copying and abridging certain of the parliamentary records then preserved in the Tower. For some reason which has not been explained, Selden never went into court as an advocate, save on rare and exceptional occasions. But his practice in chambers as a conveyancer and consulting counsel is stated to have been large, and, if we may judge from the considerable fortune he accumulated, it must also have been lucrative.

It was, however, as a scholar and writer that Selden won his reputation both amongst his contemporaries and with posterity. His first work, an account of the civil administration of England before the Norman Conquest, is said to have been completed when he was only two- or three-and-twenty years of age. But if this was the *Analecton Anglo-Britannicon*, as is generally supposed, he withheld it from the world until 1615. In 1610 appeared his *England's Epinomis* and *Janus Anglorum, Facies Altera*, which dealt with the progress of English law down to Henry II., and *The Duello, or Single Combat*, in which he traced the history of trial by battle in England from the Norman Conquest. In 1613 he supplied a series of notes, enriched by an immense number of quotations and references, to the first eighteen cantos of Drayton's *Polyolbion*. In 1614 he published *Titles of Honour*, which, in spite of some obvious defects and omissions, has remained to the present day the most comprehensive and trustworthy work of its kind that we possess; and in 1616 his notes on Fortescue's *De Laudibus Legum Angliæ* and Hengham's *Summæ Magna et Parva*. In 1617 his *De Diis Syriis* was issued from the press, and immediately established his fame as an Oriental scholar among the learned in all parts of Europe. After two centuries and a half, indeed, it is still not only the fundamental but also in many respects the best book which has been written on Semitic mythology. In 1613 his *History of Tithes*, although only published after it had been submitted to the censorship and duly licensed, nevertheless aroused the apprehension of the bishops and provoked the intervention of the king. The author was summoned before the privy council and compelled to retract his opinions, or at any rate what were held to be his opinions. Moreover, his work was suppressed and himself forbidden to reply to any of the controversialists who had come or might come forward to answer it.

This seems to have introduced Selden to the practical side of political affairs. The discontents which a few years later broke out into civil war were already forcing themselves on public attention, and it is pretty certain that, although he was not in parliament, he was the instigator and perhaps the draftsman of the memorable protestation on the rights and privileges of the House affirmed by the Commons on the 18th of December 1621. He was with several of the members committed to prison, at first in the Tower and subsequently under the charge of Sir Robert Ducie, sheriff of London. During his detention, which only lasted a short time, he occupied himself in preparing an edition of Eadmer's *History* from a manuscript lent to him by his host or jailor, which he published two years afterwards. In 1623 he was returned to the House of Commons for the borough of Lancaster, and sat with Coke, Noy, and Pym on Sergeant Glanville's election committee. He was also nominated reader of Lyon's Inn, an office which he declined to undertake. For this the benchers of the Inner Temple, by whom he had been appointed, fined him £20 and disqualified him from being chosen one of their number. But he was relieved from this incapacity after a few years, and became a master of the bench. In the first parliament of Charles I. (1625), it appears from the "returns of members" printed in 1878 that, contrary to the assertion of all his biographers, he had no seat. In Charles's second parliament (1626) he was elected for Great Bedwin in Wiltshire, and took a prominent part in the impeachment of George Villiers, duke of Buckingham. In the following year, in the "benevolence" case, he was counsel for Sir Edmund Hampden in the Court of King's Bench. In 1628 he was returned to the third parliament of Charles for Ludgershall in Wiltshire, and had a large and important share in drawing up and carrying the Petition of Right. In the session of 1629 he was one of the members mainly responsible for the tumultuous passage in the House of Commons of the resolution against the illegal levy of tonnage and poundage, and, along with Eliot, Holles, Long, Valentine, Strode, and the rest, he was sent once more to the Tower. There he remained for eight months, deprived for a part of the time of the use of books and writing materials. He was then removed, under less rigorous conditions, to the Marshalsea, until not long afterwards owing to the good offices of Archbishop Laud he was liberated. Some years before he had been appointed steward to the earl of Kent, to whose seat, Wrest in Bedfordshire, he now retired. In 1628 at the suggestion of Sir Robert Cotton he had compiled, with the assistance of two learned coadjutors, Patrick Young and Richard James, a catalogue of the Arundel marbles. He employed his leisure at Wrest in writing *De Successionibus in Bona Defuncti secundum Leges Ebræorum* and *De Successione in Pontificatum Ebræorum*, published in 1631. About this period he seems to have inclined towards the court rather than the popular party, and even to have secured the personal favour of the king. To him in 1635 he dedicated his *Mare Clausum*, and under the royal patronage it was put forth as a kind of state paper. It had been written sixteen or seventeen years before; but James I. had prohibited its publication for political reasons; hence it appeared a quarter of a century after Grotius's *Mare Liberum*, to which it was intended to be a rejoinder, and the pretensions advanced in which on behalf of the Dutch fishermen to poach in the waters off the British coasts it was its purpose to explode. The fact that Selden was not retained in the great case of ship money in 1637 by John Hampden, the cousin of his former client, may be accepted as additional evidence that his zeal in the popular cause was not so warm and unsuspected as it had once been. During the progress of this momentous constitutional conflict, indeed, he seems to have been absorbed in his Oriental researches, publishing *De Jure Naturali et Gentium juxta Disciplinam Ebræorum* in 1640. He was not elected to the Short Parliament of 1640; but to the Long Parliament, summoned in the autumn, he was returned without opposition for the university of Oxford. Immediately after the opening of the session he was nominated a member of the committee of twenty-four appointed to draw up a remonstrance on the state of the nation. He was also a member of the committees entrusted with the preliminary arrangements for the impeachment of Strafford. But he was not one of the managers at the trial, and he voted against the Bill for his attainder. He was, moreover, a member of the committees nominated to search for precedents and frame the articles of impeachment against Archbishop Laud, although it does not appear that he was implicated in the later stages of the prosecution against him. He opposed the resolution against Episcopacy which led to the exclusion of the bishops from the House of Lords, and printed an answer to the arguments used by Sir Harbottle Grimston on that occasion. He joined in the protestation of the Commons for the maintenance of the Protestant religion according to the doctrines of the Church of England, the authority of the crown, and the liberty of the subject. He was equally opposed to the court on the question of the commissions of lieutenancy of array and to the parliament on the question of the militia ordinance. In 1643, however, he became a member and participated in the discussions of the assembly of divines at Westminster, and was appointed shortly afterwards keeper of the rolls and records in the Tower. In 1645 he was named one of the parliamentary commissioners of the admiralty, and was elected master of Trinity Hall in Cambridge,—an office he declined to accept. In 1646 he subscribed the Solemn League and Covenant, and in 1647 was voted £5000 by the parliament as compensation for his sufferings in the evil days of the monarchy. He had not, however, relaxed his literary exertions during these years. He published in 1642 *Privileges of the Baronage of England when they sit in Parliament* and *Discourse concerning the Rights and Privileges of the Subject*; in 1644 *Dissertatio de Anno Civili et Calendario Reipublicæ Judaicæ*; in 1646 his treatise on marriage and divorce among the Jews entitled *Uxor Ebraica*; and in 1647 the earliest printed edition of the old and curious English law-book *Fleta*. What course he adopted with regard to the trial and execution of the king is unknown; but it is said that he refused to answer the *Eikon Basilike*, although Cromwell was anxious he should do so, the task which he declined being afterwards performed by Milton in his *Iconoclàstes*. In 1650 Selden passed the first part of *De Synedriis et Prefecturis Juridicis Veterum Ebræorum* through the press, the second and third parts being severally published in 1653 and 1655, and in 1652 he wrote a preface and collated some of the manuscripts for Sir Roger Twysden's *Historiæ Anglicæ Scriptores Decem*. His last publication was a vindication of himself from certain charges advanced against him and his *Mare Clausum* in 1653 by Theodore Graswinckel, a Dutch jurist.

After the death of the earl of Kent in 1639 Selden lived permanently under the same roof with his widow. It is believed that he was married to her, although their marriage does not seem to have ever been publicly acknowledged. He died at Friary House in Whitefriars on 30th November 1654, and was buried in the Temple Church, London. Within the last few years a brass tablet has been erected to his memory by the benchers of the Inner Temple in the parish church of West Tarring.

Several of Selden's minor productions were printed for the first time after his death, and a collective edition of his writings was published by Archdeacon Wilkins in 3 vols. folio in 1725, and again in 1726. His *Table Talk*, by which he is perhaps best known, did not appear until 1689. It was edited by his amanuensis, Richard Milward, who affirms that "the sense and notion is wholly Selden's," and that "most of the words" are his also. Its genuineness has sometimes been questioned, although on insufficient grounds. In Hallam's opinion it "gives perhaps a more exalted notion of Selden's natural talents than any of his learned writings," and in Coleridge's it contains "more weighty bullion sense" than he had "ever found in the same number of pages of any uninspired writer."

See Bliss, Wood's *Athenæ Oxonienses* (London, 1817, vol. iv.); Aikin, *Lives of John Selden and Archbishop Usher* (London, 1812); Johnson, *Memoirs of John Selden*, &c. (London, 1835); Singer, *Table Talk of John Selden* (London, 1847); and Wilkins, *Johannis Seldeni Opera Omnia*, &c. (London, 1725). (F. DR.)

SELECTION AND VARIATION. See VARIATION AND SELECTION.

SELENIUM AND TELLURIUM[1] are two rather rare chemical elements discovered, the latter by Müller von Reichenstein in 1782, the former by Berzelius in 1817. Both occur only in the mineral kingdom as components of very rare minerals, most of which are compounds of one or the other or of both and sulphur with silver, lead, bismuth, antimony, gold, and other metals.

Elementary Selenium.—This, like elementary sulphur, exists in a variety of forms, which are conveniently considered as modifications of the two genera now to be described. (1) *Non-metallic selenium* includes the flocculent scarlet precipitate produced by the reduction of solution of selenium by sulphurous acid in the cold. The scarlet flocks when dried without the aid of heat assume the form of a brown-red powder of sp. gr. 4·26, which dissolves in 1000 times its weight of boiling bisulphide of carbon (at 46°·6 C.). The solution on cooling deposits most of its selenium in the form of minute monoclinic crystals of sp.

[1] Comp. CHEMISTRY, vol. v. pp. 498, 499, 501-503, 506, 508.

gr. 4·5 (isomorphous with monoclinic sulphur), which retain their solubility in bisulphide of carbon up to 100° C. At 110° C. or higher temperatures they pass into the metallic modification (see below) with evolution of heat. With the amorphous kind a similar change sets in at or above 80° C. and attains its maximum of rapidity at a point between 125° and 180° C. Fused selenium when cooled down suddenly hardens into a very dark-coloured glass of 4·28 sp. gr., soluble in bisulphide of carbon; on gradual cooling it becomes more or less completely "metallic." (2) *Metallic selenium* is a dark grey or black solid of 4·8 sp. gr.; it exhibits metallic lustre, stretches perceptibly under the hammer, and its fracture is similar to that of grey cast iron. It is insoluble in bisulphide of carbon. Its fusing point is sharply defined and lies at 217° C. At the ordinary temperature it conducts electricity, while the non-metallic modification does not; at higher temperatures, or after temporary exposure to higher temperatures, the conductivity on either side becomes an eminently variable quantity. According to Draper and Moss, glassy selenium begins to conduct electricity at 165° to 175° C., and the conductivity increases regularly as the temperature rises to near the boiling-point. With metallic selenium, which behaves similarly, the increase of conductivity is proportional to the increase of temperature to near the fusing point (217° C.); but from this point upwards it decreases rapidly and attains its minimum at 250° C. According to W. Siemens, however, selenium by long exposure to 200° C. becomes what one may call electrically metallic; the conductivity then decreases when the temperature rises, just as it does with ordinary metals. But this electro-metallicity is not permanent; on continued exposure to a lower temperature it vanishes gradually, until the proportion of quasi-metal has fallen to a limit-value depending on that temperature. Very surprising is the observation of Sale that the electric conductivity of metallic selenium increases on exposure to the light; the red and ultra-red rays, as he found, act most powerfully. The effect of insolation is almost instantaneous, but on re-exposure to darkness the original condition is re-established only very gradually. W. Siemens found that his electro-metallic selenium (as produced at 200° C.) is more sensitive to light than any other kind. The conductivity of such selenium starting from darkness is raised twofold by diffuse and tenfold by direct sunlight. The specific heat of selenium, according to Regnault, is 0·0746 both in the glassy and in the metallic modification. Selenium (of any kind) boils at 700° C. (Mitscherlich). The vapour has an intense colour intermediate between that of chlorine and that of sulphur. According to Deville and Troost, at 880° C. it is 7·67 times, and at 1420° is 5·68 times, as heavy as air; theory, for $Se_2 = 1$ molecule, demands 5·47.

Elementary Tellurium.—This, the compact form, is a silver-white resplendent metal of markedly crystalline structure; the crystals are rhombohedra, and the ingot consequently is very brittle. Specific gravity 6·2. The metal fuses at about 500° C., and is distillable at very high temperatures. Its vapour is golden yellow and has a very brilliant absorption-spectrum. The vapour density, according to Deville and Troost, is 9·08 at 1439° C. (air = 1), corresponding to $Te_2 = 1$ molecule. A bar of tellurium becomes feebly electrical when rubbed with a woollen cloth. The electric conductivity, like that of selenium, is largely influenced by the temperature and previous exposure to heat, and it increases after exposure to light, though not to the same extent as selenium does. Starting from the ordinary temperature the conductivity decreases up to some point between 90° and 145° C.; it then increases up to 200° C. (the highest temperature tried); on cooling it decreases steadily, and finally is only one-fifth or one-sixth of what it was at 200°. The numerical value at 200° (silver = 100) was found equal to 0·0035 to 0·0031 (F. Exner).

Extraction of the Elementary Substances.—If seleniferous sulphur or pyrites is used for the manufacture of oil of vitriol by the chamber process, most of the selenium accumulates as such in the "chamber mud," from which it may be extracted by the following method of Wöhler's. The mud, after having been thoroughly washed and dried, is fused with alkaline nitrate and carbonate, to convert the selenium into selenate (SeO_4K_2 or Na_2), which is extracted by means of water. The filtered solution is boiled with hydrochloric acid to convert the selenic into selenium acid ($SeO_3 + 2HCl = Cl_2 + H_2O + SeO_2$), and this last is then reduced by addition of sulphurous acid and heating, when the selenium comes down as a red precipitate ($SeO_2 + 2SO_2 = 2SO_3 + Se$). A richer material than chamber mud is seleniferous ore-smoke as produced in Mansfeld, which likewise contains free selenium. Its extraction, according to O. Pettersen and F. Nilson, is best effected by digestion with concentrated solution of cyanide of potassium at 80° C., which converts the selenium into selenocyanide (SeNCK), easily extractable by water. The filtered solution is acidified with hydrochloric acid and allowed to stand, when the selenium (through the spontaneous decomposition of the SeNC.H into NCH and Se) comes down as a precipitate.

Tellurium is generally prepared from Transylvanian gold ore. The powdered ore is oxidized by means of hot nitric acid and the least sufficiency of hydrochloric acid, the excess of nitric acid being chased away by evaporation, and the residue mixed with sulphuric acid (to convert the lead into insoluble sulphate), and with some tartaric acid to prevent precipitation of tellurious acid (TeO_2) in the subsequent treatment with water. From the filtered aqueous solution the gold is removed by addition of ferrous sulphate and by filtration. The filtrate is treated with sulphurous acid to reduce the tellurious acid to tellurium, which separates out as a black precipitate. The precipitated metal is fused down and then sublimed at a very high temperature, in a porcelain tube, in a current of hydrogen, to remove non-volatile impurities and eliminate the last trace of selenium (SeH_2).

Chemical Relations.—Selenium and tellurium are similar in their chemical character to sulphur; the gradation of properties within the triad is in the order of the atomic weights, which are S = 32·06, Se = 79·07, Te = 128 (O = 16). In oxygen or air the elementary substances burn readily into (solid) dioxides (SeO_2, TeO_2), in the case of selenium with production of a characteristic stench of putrid radish, owing probably to the formation of a trace of hydride, SeH_2. Nitric acid, in the heat, converts sulphur directly into sulphuric acid. In the case of the two rare elements the oxidation stops at the stage corresponding to sulphurous acid. The acids SeO_3H_2 and TeO_3H_2 are not liable to further oxidation by any of the wet-way reagents (HNO_3, H_2O and Cl_2, Br_2, I_2, &c.) which convert sulphurous into sulphuric acid.

By fusion with nitre and alkaline carbonate the three elements, in their elementary or less oxygenated forms, are readily converted into salts, $R_2\Sigma O_4$ (sulphates, &c., Σ = S, Se, or Te). Selenic and telluric acids ($H_2\Sigma O_4$), unlike sulphuric, when boiled with aqueous hydrochloric acid, are gradually reduced to the lower acids (Se or Te)O_3H_2, with evolution of chlorine; and the lower acids are readily reduced to (precipitates of) elementary selenium and tellurium respectively by the action of sulphurous acid in the heat. Chlorine combines readily with elementary selenium and tellurium into dichlorides (Se or Te)Cl_2, which, however, on continued chlorination are at last completely converted into the tetrachlorides (Se or Te)Cl_4. These last, unlike the corresponding sulphur compound, are distillable without decomposition. Metals capable of uniting directly with sulphur as a rule unite also with selenium and tellurium into corresponding compounds. Hydrogen unites with elementary selenium and tellurium in the heat into gaseous hydrides (Se or Te)H_2 closely similar to sulphuretted hydrogen. But, as these hydrides are liable to dissociation, the pure compounds must be prepared by the decomposition of the zinc compounds $Zn\Sigma$ with hydrochloric acid. For the description of individual compounds reference must be made to the handbooks of chemistry. (W. D.)

SELEUCIA, or SELEUCEIA (Σελεύκεια). Of the numerous ancient towns of this name the most famous are—(1) the great city on the Tigris founded by Seleucus I. Nicator (see vol. xviii. p. 587), of the greatness and decay of which an account has been given in vol. xviii. p. 601; (2) a city on the northern frontier of Syria towards Cilicia, some miles north of the mouth of the Orontes, also founded by Seleucus I., and forming with Antioch, Apamea, and Laodicea the Syrian Tetrapolis. It served as the port of Antioch (Acts xiii. 4). Considerable ruins are still visible, especially a great cutting through solid rock, about two-thirds of a mile long, which Polybius speaks of as the road from the city to the sea.

SELEUCIDS. See MACEDONIAN EMPIRE, vol. xv. p. 142, and PERSIA, vol. xviii. p. 585 *sq.*

SELIM or SALIM, the title borne by three emperors of the Ottoman Turks. For SELIM I., emperor from 1512 to 1520, see PERSIA, vol. xviii. pp. 635-636, and TURKEY. SELIM II., grandson of the preceding, was sultan from 1566 to 1574. See TURKEY. SELIM III., son of Sultan Mustapha III., succeeded his father in 1789 and was deposed in 1807. See TURKEY.

SELIMNIA. See SLIVEN.

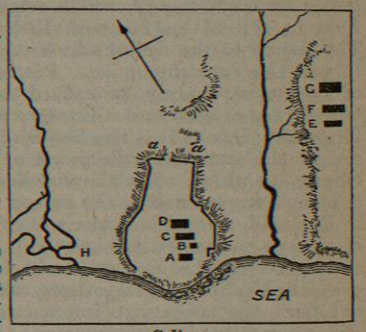
SELINUS (Σελινοῦς), one of the most important of the Greek colonies in Sicily, near the rivers Hypsas and Selinus on the south-west coast, was founded, probably about 628 B.C., by colonists from Megara Hyblæa in the east of Sicily and others from the parent city of Megara on the Saronic Gulf of Greece (see Thuc., vi. 4, vii. 57, and Strabo, vi. p. 272). The name of the city and the little river (see H in fig.) on which it stands was derived from the wild parsley (σέλινον) which grew there in abundance (comp. vol. xvii. p. 639). Many autonomous coins of Selinus exist, dating from the 5th and 4th centuries B.C. The tetradrachms have on the obverse a youth, representing the river Selinus, sacrificing at an altar,[1] and, in the field, a parsley leaf,—legend, ΣΕΛΙΝΟΣ; on the reverse, Apollo and Artemis in a biga,—legend, ΣΕΛΙΝΟΝΤΙΟΝ (retrograde). Didrachms have a similar obverse with the river Hypsas,—legend, ΗΥΨΑΣ; reverse, Heracles slaying a bull,—legend, ΣΕΛΙΝΟΝΤΙΟΝ. As early as 580 B.C. the citizens of Selinus were at war with the adjoining people of Segesta, a non-Hellenic race who occupied the province north of Selinus; the success of the Segestans on this occasion was mainly owing to aid given them by colonists from Rhodes and Cnidus. Little is known about the early history of Selinus; but the city evidently grew rapidly in wealth and importance, and soon extended its borders 15 miles westwards to the river Mazarus and eastwards as far as the Halycus (Diod., xiii. 54; Herod., v. 46). Thucydides (vi. 20) mentions its power and wealth and especially the rich treasures in its temples. From its early oligarchical form of government Selinus passed to a short-lived despotism under the tyrant Pithagoras, who was deposed soon after 510 B.C. In 480 B.C., when the Carthaginian Hamilcar invaded Sicily, the city took his side against their fellow Hellenes. In 416 B.C. a new dispute between Selinus and Segesta was eventually the cause of the fatal Athenian expedition against Sicily, the Athenians acting as allies of Segesta and the Syracusans as allies of Selinus. The conclusion of this expedition (see SYRACUSE) left Segesta at the mercy of the Selinuntines, whose rapacity and cruelty soon brought about their own destruction, through the aid which the Segestans obtained from Carthage. In 409 B.C. Hannibal, with an overwhelming force, took and destroyed the city, the walls of which were razed to the ground. He killed about 16,000 of the inhabitants, took 5000 prisoners, and only a remnant of 2600 escaped to Agrigentum (Diod., xiii. 54-59). The survivors were afterwards allowed to return and to rebuild Selinus as a city subject to the Carthaginians, under whose yoke, in spite of their attempts to regain freedom, the Selinuntines remained till *c.* 250, the close of the First Punic War; after this the Carthaginians transferred the inhabitants of Selinus to Lilybæum, and completely destroyed the city (Diod. xxiv.). It was never rebuilt, and is mentioned by Strabo (vi. p. 272) as being one of the extinct cities of Sicily.[2]

[1] Sculptured on the altar is a cock, in allusion to the aid given by Æsculapius against the fever which was caused by the marshy site. Drainage works directed by Empedocles are said to have rendered the site healthy (Diog. Laer., viii. 2, 11).

[2] Roman sulphur baths existed under the name Thermæ Selinuntiæ, but these were about 20 miles east of the site of the ancient Selinus.

The ancient city occupied two elevated plateaus at the edge of the sea and also part of the surrounding plain. The western of these elevations formed the acropolis; on the other was the agora. The walls of the acropolis can still be traced round the whole circuit: the only entrance was on the north-east. Remains also exist of long walls connecting the city and its port. The chief glory of Selinus was its double group of great temples,—three on the acropolis and three in the agora, one of which was the largest peripteral temple in the world. All are completely ruined, but the materials of each still remain almost perfect, though scattered in confused heaps of stone; the extraordinary completeness of these fragments is owing to the fact that the site has never been occupied since the final transference of the inhabitants in 250 B.C., and thus the scattered blocks have never been taken as materials for later structures. Of all the six temples[3] none are later than the 5th century B.C., and those on the acropolis probably date from about 628 B.C., soon after the first settlement. The sculptured metopes from three of the temples are among the most important examples of early Hellenic art (see ARCHÆOLOGY, vol. ii. p. 349, and Benndorf, *Die Metopen von Selinunt*). The buildings themselves are of the highest interest, being the earliest known examples of the Doric style, and differing in many important details from all other examples, even such early ones as the temples at Corinth and Syracuse.

The three temples on the acropolis (A, C, D in fig.) stand side by side, with their axes north-west to south-east; all are hexastyle and peripteral, with either thirteen or fourteen columns on the sides. Their stylobates have four high steps along the sides, with an easier approach of more steps at the north-west fronts. To the middle one of the three belong the very archaic metopes described in vol. ii. p. 349. All have a rather narrow cella with pronaos and opisthodomus. Their archaic peculiarities are the rapid diminution of the columns, the absence of entasis, the narrow mutules over the metopes, and especially a curious cavetto or necking under the usual hypotrachelia. No other example of this feature was known till 1884, when Dr Schliemann and Dr Dörpfeld discovered a similar Doric capital among the ruins of the citadel of Tiryns. The Tiryns capital dates probably from a little before 600 B.C. and appears to be nearly contemporary with that at Selinus. Between temples A and C are remains of a small prostyle tetrastyle ædicula (B) of the Doric order.[4] The second group of three Doric temples (E, F, G) belongs to a rather later date,—probably 500 to 440 B.C. The first two (E and F) have very narrow cellæ, so that they are pseudo-dipteral. They also are hexastyle, with fourteen columns on the sides. Though still early in detail, they are without the curious necking of the acropolis temples. The sculptured metopes of temple E are of extraordinary beauty and interest, and appear to date from the finest period of Greek art—the age of Phidias or perhaps that of Myron. The chief subjects are Zeus and Hera on Mount Olympus, Artemis and Actæon, and Heracles defeating an Amazon. They are of the noblest style, simple and highly sculpturesque in treatment, and full of grace and expression. One remarkable peculiarity in their technique is that the nude parts of the female figures (heads, feet, and hands) are executed in white marble, while the rest of the reliefs are in the native grey tufa, which originally was covered with marble-dust stucco and then painted. The whole of the stonework of all the temples was treated in a similar way, and gives most valuable examples of early Greek coloured decoration. Recent excavations at Selinus have shown that in many cases the cornices and other architectural features were covered with moulded slabs of terra cotta, all richly coloured



Selinus.

A, C, D, Temples on acropolis. B, Small prostyle tetrastyle ædicula. E, F, G, Temples on eastern hill. *a*, *a*, Remains of buildings outside acropolis walls. H, River Selinus.

[3] The stone of which all these temples were built came from a quarry a few miles north-west of Selinus (mod. Campobello). The ancient workings are very visible, and unfinished drums of columns and other blocks still exist in the quarry. It is a brown tufa-like stone.

[4] Strange to say, Hittorff and Zanth (*Architecture Antique de Sicile*, Paris, 1870), in their elaborate work on this subject, restore this ædicula with a Doric entablature on Ionic columns; a good many other similar absurdities occur in this richly illustrated work. More judgment is shown in Serradifalco's *Antica Selinunto* (Palermo, 1831-42), though it is not always accurate in measurements.