

produce large fissures in the ice, and the consequent sliding of one detached part over another, but rather the effect of a general bruise over a considerable space of the yielding body. According to this view, the delicate veins seen in the glacier, often less than a quarter of an inch wide, have their course parallel to the direction of the sliding effort of one portion of the ice over another. Amongst other proofs of this fundamental conception that the veined structure is the external symbol of this forced internal motion of a body comparatively solid, Forbes cited a striking instance from the glacier of La Brenva, on the south side of Mount Blanc. In this case the ice of the glacier, forcibly pressed against the naked rocky face of an opposing hill is turned into a new direction; and in thus shoving and squeezing past a prominence of rock, he observed developed in the ice a "veined structure" so beautiful that "it was impossible to resist the wish to carry off slabs, and to perpetuate it by hand specimens." This perfectly developed structure was visible opposite the promontory which held the glacier in check, and past which it struggled, leaving a portion of its ice completely embayed in a recess of the shore behind it. Starting from this point as an origin, the veined laminae extended backwards and upwards into the glacier, but did not spread laterally into the embayed ice. They could, however, be traced from the shore to some distance from the promontory into the icy mass. The direction of lamination exactly coincided with that in which the ice must have moved if it was shoved past the promontory at all. That it did so move was made the subject of direct proof, by fixing two marks on the ice opposite the promontory, one on the nearer, the other on the farther side of the belt of ice which had the lamination best developed. The first mark was 50 feet from the shore, and moved at the rate of 4.9 inches daily; the other mark was 170 feet further off, and moved almost three times faster, or 14.2 inches daily. Throughout this breadth of 170 feet there was not a single longitudinal crevasse which might have facilitated the differential motion. A parallelogram of compact ice, only 170 feet wide, was therefore moving in such a manner that, whilst one of its sides advanced only a foot, the other advanced a yard. No solid body, at least no rigid solid body, can advance in such a manner; Forbes therefore concluded that glacier-ice is plastic, that the veined structure is unquestionably the result of the struggle between the rigidity of the ice and the quasi-fluid character of the motion impressed upon it, and that this follows, not only from the direction of the laminae, but from their becoming distinct exactly in proportion to their nearness to the point where the bruise is necessarily strongest. The subsequent experiments of Sorby on the cleavage structure of rocks proved that it has arisen as the result of intense lateral compression, and could be imitated in many artificial substances. Tyndall obtained it even in beeswax, the analogy between which and the veined structure of ice is very close.

Though Forbes termed his expression of the laws of glacier motion the "viscous" or "plastic theory," it was rather a statement of fact than an explanation of the physical processes concerned in the descent of glaciers. Against his views it was of course objected that ice is by its nature a brittle solid, and not sensibly possessed of any viscous or plastic quality. But he cogently replied that the qualities of solid bodies of vast size, and acted on by stupendous and long-continued forces, cannot be estimated from experiments on a small scale, especially if short and violent; that sealing-wax, pitch, and other similar bodies mould themselves, with time, to the surfaces on which they lie, even at atmospheric temperatures, and whilst they maintain, at the same time, the quality of excessive brittleness under a blow or a rapid change of form; that even ice does not pass at once, and *per saltum*, from the solid to the liquid state, but absorbs its latent heat through-

out a certain small range of temperature (between 28° 4 and 32° of Fahrenheit), which is precisely that to which the ice of glaciers is actually exposed; that, after all, a glacier is not a crystalline solid, like ice, tranquilly frozen in a mould, but possesses a peculiar fissured and laminated structure, through which water enters (at least for a great part of the year) into its intrinsic composition. He insisted that the quasi-fluid or viscous motion of the ice of glaciers is not a theory but a fact. A substance which is seen to pour itself out of a large basin through a narrow outlet without losing its continuity; the different parts of which, from top to bottom, and from side to centre, possess distinct though related velocities; which moves over slopes inconsistent with the friction between its surface and the ground on which it rests; which surmounts obstacles, and even if cleft into two streams by a projecting rock, instead of being thereby anchored as a solid would necessarily be, reunites its streams below, and retains no trace of the fissure, leaving the rock an islet in the icy flood,—a substance which moves in such a fashion cannot, Forbes maintained, in any true sense of the word, be termed a rigid solid, but must be granted to be ductile, viscous, plastic, or semifluid, or to possess qualities represented by any of these terms which we may choose to adopt as least shocking to our ordinary conception of the brittleness of ice.

The problem of the cause of glacier-motion cannot yet be considered to be satisfactorily solved. One of the most important contributions to the solution of this question was made by Professor James Thomson when he predicted that the freezing point of ice must be lowered by pressure, and when he sought by means of this property to explain the plastic or viscous behaviour of glaciers contended for by Forbes. This prediction was experimentally verified by his brother, Sir W. Thomson. Tyndall subsequently to Forbes's work brought forward an explanation termed the "pressure or fracture and regelation theory." Some experiments of Faraday in 1850 had shown that two pieces of ice with moistened surfaces would if in contact adhere, owing to the freezing of the thin film of water between them, while at a lower temperature than 32°, and with consequently dry surfaces, no adhesion took place. The freezing was obtained even under warm water. Starting from those observations Tyndall was led to make experiments on the effects of compression upon ice, and found that a quantity of pounded ice could be moulded into a compact homogeneous mass. This property possessed by ice of reuniting by pressure after fracture was termed regelation, and was applied by Tyndall in explanation of the motion of glaciers. He maintained that the ice of a glacier is a solid brittle substance, and that its descent down a valley is due to constant rupture produced by the effects of gravitation and to the consequent sliding forward of the mass in which the surfaces of fracture speedily reunite. He pointed more particularly to the ice-falls of glaciers where the ice in passing over a steep descent and undergoing great tension does not yield as a viscous body, but is fractured as a solid. More recently Canon Mosely investigated the physics of glaciers, especially by determining the shearing force of the ice. He found that in a glacier of such a uniform section and slope, moving at such a uniform rate, as the Mer de Glace at Les Ponts, the aggregate resistance offered by the ice to its descent is about 34 times greater than the force of gravitation. He therefore concluded it to be physically impossible that a glacier could slide down its valley by its own weight, and consequently that the gravitation or fracture and regelation theory could not be maintained. The slow descent of sheet lead on a roof of moderate inclination, and its ability even to draw out from the rafters the nails with which it had been fastened, led him to propound another theory of glacier-motion, viz., that it is due to expansion

and contraction caused by changes of solar heat. He contended that the ice, like the lead, is expanded by heat, and that, as it cannot on expansion move up the valley without overcoming the resistance of gravitation as well as of friction, it necessarily moves chiefly downward, in which direction gravitation co-operates. Contraction on the other hand must also tend to send the ice downward, for a larger part will move with the force of gravitation than against it. Dr Croll, objecting to Canon Mosely's views that no observed alternations of glacier temperature warrant the conclusion that the ice can be impelled downward by that cause, has proposed yet another explanation. He regards the motion of the ice of a glacier as molecular, resulting from the very conduction of heat through the mass of the glacier. He contends that from the thermal conditions of glacier-ice its molecules will melt before their temperature can be raised. Any given molecule on melting will transmit its extra heat or part of it to the next molecule, which in turn may melt, and thus a wave of thaw will travel through the ice. But as each molecule loses its heat again it freezes, and in the act of solidification exerts an enormous pressure on the walls of the interstice into which while fluid it entered. Hence in proportion to the amount of heat received by it the ice is subjected to great molecular pressure. As the glacier cannot expand laterally on account of the walls of its channel, and as gravitation opposes its expansion up the valley, it necessarily finds relief by a downward movement—the direction in which gravitation co-operates.

See De Saussure's *Voyages dans les Alpes*, § 535; De Charpentier, *Essai sur les Glaciers*, 1841; Agassiz, *Études sur les Glaciers*, 1840, *Système Glaciaire*, 1847; L'Abbé Rendu, "Théorie des Glaciers de la Savoie," in *Mem. Acad. Savoie*, x., 1841, translated by G. Forbes and published 1875; J. D. Forbes, *Travels in the Alps*, 1843, *Norway and its Glaciers*, 1853, and *Occasional Papers on Glaciers*, 1859; Tyndall's *Glaciers of the Alps*, 1857; Mousson's *Gletscher der Jetztzeit*, 1854; Mosely, *Proc. Roy. Soc.*, 1869; Croll, *Climate and Time*, 1875; J. Thomson, *Proc. Roy. Soc.*, 1856-7.

GLADBACH, usually called BERGISCH-GLADBACH, a town of Prussia, circle of Mülheim, government district of Cologne, is situated 8 miles N.E. of the latter town. It possesses an iron foundry, and manufactories of paper, pasteboard, powder, percussion caps, nets, and machinery. Ironstone, peat, and lime are found in the vicinity. The population in 1875 was 7030.

GLADBACH, or MÖNCHEN-GLADBACH, a flourishing and rapidly increasing manufacturing town of Rhenish Prussia, capital of a circle in the government district of Düsseldorf, is situated 16 miles W.S.W. of the town of that name. It is one of the chief manufacturing seats of Rhenish Prussia, its principal industries being the spinning and weaving of cotton, the manufacture of silks, velvet, ribbons, and damasks, and dyeing and bleaching. There are also tanneries, tobacco manufactories, machine works, and foundries. The town possesses a chamber of commerce, a gymnasium, and a female school of the higher grade. There are an Evangelical and three Catholic churches, one of which possesses a choir of 1250, a nave dating from the beginning of the 12th century, and a crypt of the 8th century. Gladbach existed before the time of Charlemagne, and a Benedictine monastery was founded near it in 972 by Archbishop Gero of Cologne. The population in 1855 was only 4398; but it had increased in 1858 to 13,965, in 1861 to 17,074, in 1871 to 26,354, and in 1875 to 31,962.

GLADIATORS, professional combatants with men or beasts in the Roman arena. That this form of spectacle, which is almost peculiar to Rome and the Roman provinces, was originally borrowed from Etruria is shown by various indications. On an Etruscan tomb discovered at Tarquinii there is a representation of gladiatorial games; the slaves employed to carry off the dead bodies from the arena wore masks representing the Etruscan Charon; and we learn

from Isidore of Seville that the name for a trainer of gladiators, *lanista*, is an Etruscan word meaning butcher or executioner. These games are evidently a survival of the practice of immolating slaves and prisoners on the tomb of illustrious chieftains, a practice recorded in Greek, Roman, and Scandinavian legends, and traceable even as late as this century in the Indian suttee. Even at Rome they were for a long time confined to funerals, and hence the older name for gladiators was *bustuarii*; but in the later days of the republic their original significance was forgotten, and they formed as indispensable a part of the public amusements as the theatre or the circus.

The first gladiators are said, on the authority of Valerius Maximus, to have been exhibited at Rome in the Forum Boarium 264 B.C., by Marcus and Decimus Brutus at the funeral of their father. On this occasion only three pairs fought, but the taste for these games spread rapidly, and the number of combatants grew apace. In 174 B.C. Titus Flamininus celebrated his father's obsequies by a three days' fight, in which 74 gladiators took part. Julius Cæsar engaged such extravagant numbers for his ædileship, that his political opponents took fright, and carried a decree of the senate imposing a certain limit of numbers; but notwithstanding this restriction he was able to exhibit no less than 300 couples. During the later days of the republic the gladiators were a constant element of danger to the public peace. The more turbulent spirits among the nobility had each his band of gladiators to act as a body guard, and the armed troops of Clodius, Milo, and Catiline played the same part in Roman history as the armed retainers of the feudal barons or the condottieri of the Italian republics.

Under the empire, notwithstanding sumptuary enactments, the passion for the arena steadily increased. Augustus, indeed, limited the shows to two a year, and forbade a prætor to exhibit more than 120 gladiators, yet allusions in Horace and Persius show that 100 pairs was the fashionable number for private entertainments; and in the Marmor Ancyranum the emperor states that more than 10,000 men had fought during his reign. The imbecile Claudius was devoted to this pastime, and would sit from morning till night in his chair of state, descending now and then to the arena to coax or force the reluctant gladiators to resume their bloody work. Under Nero senators and even well-born women appeared as combatants; and Juvenal has handed down to eternal infamy the descendant of the Gracchi that appeared without disguise as a *retiarius*, and begged his life from the *secutor*, who blushed to conquer one so noble and so vile. Titus, whom his countrymen surnamed the Clement, ordered a show which lasted 100 days; and Trajan, in celebration of his triumph over Decebalus, exhibited 5000 pairs of gladiators. Domitian instituted *venationes* by torchlight, and at the Saturnalia of 90 A.D. arranged a battle between dwarfs and women. Even as late as 200 A.D. an edict was passed forbidding women to fight. How widely the taste for these sanguinary spectacles extended throughout the Roman provinces is attested by monuments, inscriptions, and the remains of vast amphitheatres. From Britain to Syria there was not a town of any size that could not boast its arena and annual games. The following inscription copied from the pedestal of a statue shows the important part they played in provincial life:—"In four days, at Minurnæ, he showed eleven pairs of gladiators, who did not cease fighting till one half, all the most valiant men in Campania, had fallen. You remember it well, noble fellow citizens." After Italy, Gaul, North Africa, and Spain were most famous for their amphitheatres; and Greece was the only Roman province where the institution never took root.

Gladiators were commonly drawn either from prisoners of war, or slaves, or criminals condemned to death. Thus

in the first class we read of tattooed Britons in their war chariots, Thracians with their peculiar bucklers and scimitars, Moors from the villages round Atlas, and negroes from central Africa, exhibited in the Colosseum. Down to the time of the empire only greater malefactors, such as brigands and incendiaries, were condemned to the arena; but by Caligula, Claudius, and Nero this punishment was extended to minor offences, such as fraud and peculation, in order to supply the growing demand for victims. For the first century of the empire it was lawful for masters to sell their slaves as gladiators, but this was forbidden by Hadrian and Marcus Aurelius. Besides these three regular classes, the ranks were recruited by a considerable number of freedmen and Roman citizens who had squandered their estates, and voluntarily took the *auctoramentum gladiatorum*, by which for a stated time they bound themselves to the *lanista*. Even men of birth and fortune not seldom entered the lists, either for the pure love of fighting, or to gratify the whim of some dissolute emperor; and one emperor, Commodus, actually appeared in person in the arena.

Gladiators were trained in schools (*ludi*) owned either by the state or by private citizens; and though the trade of a *lanista* was considered disgraceful, to own gladiators and let them out for hire was reckoned a legitimate branch of commerce. Thus Cicero, in his letters to Atticus, congratulates his friend on the good bargain he had made in purchasing a band, and urges that he might easily recoup himself by consenting to let them out twice. Men recruited mainly from slaves and criminals, whose lives hung on a thread, must have been more dangerous characters than modern galley slaves or convicts; and, though highly fed and carefully tended, they were of necessity subject to an iron discipline. In the school of gladiators discovered at Pompeii, of the sixty-three skeletons buried in the cells many were in irons. But hard as was the gladiator's lot,—so hard that special precautions had to be taken to prevent suicide,—it had its consolations. A successful gladiator enjoyed far greater fame than any modern prize-fighter or athlete. He was presented with broad pieces, chains, and jewelled helmets, such as may be seen in the museum at Naples; poets like Martial sang his prowess; his portrait was multiplied on vases, lamps, and gems; and high-born ladies contended for his favours. Mixed, too, with the lowest dregs of the city, there must have been many noble barbarians condemned to the vile trade by the hard fate of war. There are few finer characters in Roman history than the Thracian Spartacus, who, escaping with seventy of his comrades from the school of Lentulus at Capua, for three years defied the legions of Rome; and after Antony's defeat at Actium, the only part of his army that remained faithful to his cause were the gladiators whom he had enrolled at Cyzicus to grace his anticipated victory.

There were various classes of gladiators, distinguished by their arms or modes of fighting. The Samnites fought with the national weapons—a large oblong shield, a vizard, a plumed helmet, and a short sword. The Thracians had a small round buckler and a dagger carved like a scythe; they were generally pitted against the Mirmillones, so called from the fish (*μυρμίδος*) which served as the crest of their helmet. In like manner the Retiarius was matched with the Secutor: the former had nothing on but a short tunic or apron, and sought to entangle his pursuer, who was fully armed, with the cast-net (*jaculum*) that he carried in his right hand; and if successful, he despatched him with the trident (*tridens, fuscina*) that he carried in his left. We may also mention the Andabatae, who wore helmets with closed vizors; the Dimachæri of the later empire; the Essedarii, who fought from chariots like the ancient Britons; the Hoplomachi, armed like a Greek hoplite; and the Laqueatores, who tried to lasso their antagonists.

The estimation in which gladiatorial games were held by Roman moralists deserves notice, and the influence that they exercised upon the morals and genius of the nation. The Roman was essentially cruel, not so much from spite or vindictiveness, as from callousness and defective sympathies. This element of inhumanity and brutality must have been deeply ingrained in the national character to have allowed the games to become popular, but there can be no doubt that it was fed and fostered by the savage form which their amusements took. That the sight of bloodshed provokes a love of bloodshed and cruelty is a commonplace of morals. To the horrors of the arena we may attribute in part, not only the brutal treatment of their slaves and prisoners, but the frequency of suicide among the Romans. On the other hand, we should be careful not to exaggerate the effects or draw too sweeping inferences from the prevalence of this degrading amusement. Human nature is happily illogical; and we know that many of the Roman statesmen who gave these games, and themselves enjoyed these sights of blood, were in every other department of life irreproachable,—indulgent fathers, humane generals, and mild rulers of provinces. In the present state of society it is difficult to conceive how a man of taste can have endured to gaze upon a scene of human butchery. Yet we should remember that it is less than half a century since bear-baiting was prohibited in England, and we are only now attaining that stage of morality in respect of cruelty to animals that was reached in the 5th century, by the help of Christianity, in respect of cruelty to men. We shall not then be greatly surprised if hardly one of the Roman moralists is found to raise his voice against this amusement, except on the score of extravagance. Cicero, in a well-known passage commends the gladiatorial games as the best discipline against the fear of death and suffering that can be presented to the eye. The younger Pliny, who perhaps of all Romans approaches nearest to our ideal of a cultured gentleman, speaks approvingly of them. Marcus Aurelius, though he did much to mitigate their horrors, yet in his writings condemns the monotony rather than the cruelty. Seneca is indeed a splendid exception, and his letter to Lentulus is an eloquent protest against this inhuman sport. But it is without a parallel till we come to the writings of the Christian fathers, Tertullian, Lactantius, Cyprian, and Augustine. In the *Confessions* of the last there occurs a narrative which is worth quoting as a proof of the strange fascination which the games exercised even on a religious man and a Christian. He tells us how his friend Alpius was dragged against his will to the amphitheatre, how he strove to quiet his conscience by closing his eyes, how at some exciting crisis the shouts of the whole assembly aroused his curiosity, how he looked and was lost, grew drunk with the sight of blood, and returned again and again, knowing his guilt yet unable to abstain. The first Christian emperor was persuaded to issue an edict abolishing gladiatorial games (325), yet in 404 we read of an exhibition of gladiators to celebrate the triumph of Honorius over the Goths, and it is said that they were not totally extinct in the West till the time of Theodoric (see GAMES).

Gladiators formed admirable models for the sculptor. One of the finest pieces of ancient sculpture that has come down to us is the Wounded Gladiator of the National Museum at Naples. The so-called Fighting Gladiator of the Borghese collection, now in the Museum of the Louvre, and the Dying Gladiator of the Capitoline Museum, which inspired the famous stanza of *Childe Harold*, have been pronounced by modern antiquaries to represent, not gladiators, but warriors. In this connexion we may mention the admirable picture of Gérôme which bears the title, *Ave, Caesar, morituri te salutant*.

The attention of archaeologists has been recently directed to the *tessera* of gladiators. These *tesserae*, of which about sixty exist in various museums, are small oblong tablets of ivory or bone, with an inscription on each of the four sides. The first line contains a name in the nominative case, presumably that of the gladiator; the second line a name in the genitive, that of the *patronus* or *dominus*; the third line begins with the letters SP, for *spectator* or approved, which shows that the gladiator had passed his preliminary trials; this is followed by a day of a Roman month; and in the fourth line are the names of the consuls of a particular year.

Lipsius, *Saturnalia*, Wesel, 1675; Friedländer, *Darstellungen aus der Sitten-geschichte Roms*, Leipzig, 1869; H. Goell, *Kulturbilder aus Hellas und Rom*, Leipzig, 1863; Charles Magnin, *Les Origines du théâtre moderne*, Paris, 1838; H. Wallon, *Histoire de l'esclavage*, Paris, 1847; Guhl and Koner, *The Life of the Greeks and Romans*; Lecky, *History of European Morals*, (F. S.)

GLADIOLUS, a genus of monocotyledonous or endogenous plants, belonging to the natural order *Iridaceae*, and representative of the tribe *Gladioleae*, a group of bulbous plants in which the perianth is irregular, and the stamens unilateral and arched, with the filaments free. It belongs to a subdivision of the *Gladioleae*, in which the segments of the limb of the perianth are very unequal, and is especially distinguished by having the perianth tube curved, funnel-

shaped, and widening upwards, and by the segments equalling or exceeding the tube in length. About ninety species are described, of which number upwards of fifty are from the Cape, and the rest from tropical Africa, the central and southern regions of Europe, Persia, the Caucasus, and the Levant. One species, *G. illyricus*, is found apparently wild in England, in the New Forest, Hampshire. Some of the species have been cultivated for a long period in our flower-gardens, where both the introduced species and the modern varieties bred from them are very ornamental and popular. *G. segetum* has been cultivated since 1596, and *G. byzantinus* since 1629, while many additional species were introduced during the latter half of the 18th century. One of the earlier of the hybrids originated in gardens was the beautiful *G. Colvillii*, raised in the nursery of Mr Colvill of Chelsea in 1823 from *G. concolor* fertilized by *G. cardinalis*. In the first decade of the century, however, the Hon. and Rev. W. Herbert had successfully crossed the showy *G. cardinalis* with the smaller but more free-flowering *G. blandus*, and the result was the production of a race of great beauty and fertility. Other crosses were made with *G. tristis*, *G. oppositiflorus*, *G. hirsutus*, *G. alatus*, and *G. natalensis*; but it was not till after the production of *G. gandavensis* about 1843, by the crossing of *G. natalensis* with *G. oppositiflorus* (sometimes erroneously attributed to *natalensis* and *cardinalis*), that the gladiolus may be said to have become a general favourite in gardens. Since that time the varieties have been greatly multiplied in number, and improved in size and quality, as well as marvellously varied in colour and marking, so that they have now become exceedingly popular. A few years since large numbers of novel varieties were annually introduced by the French florists, but the English-raised varieties are now in great measure superseding them. One cultivator, Mr Kelway of Langport, devotes a space of not less than 8 acres to gladioli, and cultivates annually from 10,000 to 60,000 each of some of the more popular kinds, while seedlings are raised to the extent of half a million a year. The seeds are sown in the open ground about April, glass culture with so large a number being out of the question; and in the first season the young plants make bulbs averaging the size of peas. The time occupied from the sowing of the seed until the plant attains its full strength is from three to four years. The approved sorts, which are identified by name, are multiplied by means of bulbets or offsets which form around the principal bulb or corm; but in this they vary greatly, some kinds furnishing abundant increase and soon becoming plentiful, while others persistently refuse to yield offsets. The stately habit and rich glowing colours of the modern gladioli render them exceedingly valuable as decorative plants during the late summer months. They are, moreover, very desirable and useful flowers for cutting for the purpose of room decoration, for while the blossoms themselves last fresh for some days, the undeveloped buds open in succession, if the stalks are kept in water, so that a cut spike will go on blooming for a considerable period.

GLAMORGAN (Welsh, *Gwlad Morgan*), a maritime county of South Wales, bounded on the N. by Brecknock and Carmarthen, on the W. by Carmarthen and its bay, on the S. by the Bristol Channel, and on the E. by Monmouth, the boundary line of which is the Rhymney. Its greatest length from E. to W. is about 53 miles, its greatest breadth from N. to S. about 29; its coast-line is about 60 miles, and its area 547,070 acres.

Glamorgan, with the exception of some flat tracts on the borders of the Bristol Channel, consists of a succession of hills and valleys, the country inland growing more and more mountainous, after a broad tract of plain on the south coast, until on the borders of Brecknock its surface is a sea of hills. None of the mountains rise to a great height,

the most lofty, Mynydd Llangeinor, being but 1859 feet, and the escarpment of Craig y Llyn about the same height or a little higher. Yet their bold forms add grandeur to the scenery of the county, and their lower slopes are clothed with picturesque though not large timber.

The valleys of Glamorgan have been long famous for great beauty of scenery. The vale of Glamorgan, some 8 miles in breadth, has been truly called the "Garden of Wales," and its climate is so mild that myrtles and other tender plants flourish in the open air. The vale of Neath is known to tourists as the waterfall district of South Wales, the finest falls being betwixt Hirwain and Neath, near the Vale of Neath Railway, viz. Cilhepstê fall, the three Clwngwyns, the falls of the Pyrddin, Sewd-Eion Gam, Sewd-Gladys, and Sewd Hen Rhydd on the Llech, with Melincourt and Abergarwedd still nearer Neath. The highest of these falls are above 80 feet. Swansea valley has also fine scenery. Other valleys are those of the Rhymney, the Taff, the Rhondda, and the Llwchwr, the first two giving their names to important railways.

The rivers of Glamorgan are not large. The chief are the Rhymney, forming the county's eastern boundary; the Ogwr or Ogmog, which flows into the Bristol Channel near Porth-Cawl harbour; the Taff, which rises in the Brecon Beacon, flows southward through the county, and forms the important harbour of Cardiff; the Neath and Tawe, flowing south into Swansea Bay; and the Llwchwr, which is the boundary of the county on the west, and, falling into Carmarthen Bay, forms the estuary of the Burry river.

The chief geological feature of Glamorgan is the Coal-measures, which are of the greatest thickness near Neath, but extend nearly over the whole county, and are bounded by a narrow band of Millstone Grit and Mountain Limestone, nearly coincident with the county boundary on the north. In the extreme south and south-west the Devonian, Magnesian Limestone, and the Lias show themselves.

The climate is mild, and the plains on the coast as well as inland are very fertile. The soil is a deep rich loam, improved by lime. Agriculture is as yet not so forward as it might be with such a soil and climate; but the farms are seldom large, and the buildings are not suited to high farming. The crops chiefly raised are wheat, beans, pease oats, barley, vetches, turnips, and potatoes. The cattle are of good useful breeds; and good sheep and ponies are reared in the hill-country. According to the agricultural statistics for 1878, the extent under the different crops (the total area being 547,070 acres), and the numbers of live-stock, were as follows:—

Corn crops (two-thirds wheat and oats, and nearly one-third barley).....	37,139 acres
Green crops (two-thirds turnips and swedes).....	15,054 "
Grass under rotation.....	26,468 "
Permanent pasture.....	186,697 "
Bare, fallow, and uncropped arable land.....	33,359 "
Total under crops, bare fallow, and grass.....	268,707 "

Live Stock:—Horses, including ponies.....	13,727
Cattle.....	46,545
Sheep.....	283,389
Pigs.....	15,572

According to the Owners and Heritages Return 1872–73, the county was divided among 8426 proprietors, holding 428,386 acres, with a gross estimated annual rental of £1,609,379. The estimated amount of commons and waste lands was 47,018 acres. Of the owners, 78.8 per cent. possessed less than one acre, and the average value per acre was £3, 1s. 8½d. There were 16 proprietors holding 5000 acres and upwards, viz., C. R. M. Talbot 33,920; Earl of Dunraven, 23,706; Marquis of Bute, 21,402; Lord Windsor, 12,016; Earl of Jersey, 7110; Edward Rees Wingfield, 6463; Lord Tredegar,

6157; Major Vaughan Lee, 6128; Mrs Blandy Jenkins, 6082; Col. K. Lynte, 5933; Sir Iver B. Guest, 5640; T. Penrice, 5411; Mrs Chetwode, 5399; R. F. L. Jenner, 5381; C. Bailey, 5343; John D. Llewellyn, 5000.

The industry of Glamorgan is chiefly applied to its coal and iron mines, which practically underlie the whole superficies of the county, and give it its pre-eminence among Welsh counties. In 1872 there were no less than 420 coal-pits in Monmouthshire and South Wales, and the yield of some 15 million tons a year came in very large proportion from the Glamorganshire vales of Neath, Taff, Rhondda, Ely, &c. Within the last twenty years the iron works were carried on at an enormous scale of labour and enterprise, there being near Merthyr-Tydvil alone upwards of 60 blast furnaces; but in 1873 it appeared that of 57 furnaces in Glamorganshire 27 were out of blast, and at present (1879) the industry is, from various causes, in a backward state. Excellent means of export for coal and iron are afforded by the unrivalled docks at Cardiff, the enterprise of the late and present marquis of Bute, and by those also at Penarth at the mouth of the Ely. These have within considerably less than a century transformed an insignificant Welsh town into a leading port and emporium with a first rate harbour and anchorage; whilst another dock at Swansea serves a like purpose for the export of the copper ore smelted at Swansea, Neath, Aberavon, and Treforest, and chiefly sold at public ticketings in the first-named town. Cardiff and Swansea, especially the latter, also have a very large export trade in patent compressed fuel prepared from culm and tar.

Glamorgan can boast historic ruins, such as Caerphilly, and Castle Coch near Llandaff, the former a Norman fortress held for Edward II. by the younger De Spencer, the latter an early English fortress on an escarpment of mountain limestone. Other ruined castles are Oystermouth and Pennard in Gower, and Coity near Bridgend; while as restored castles, resided in by their present owners, are Cardiff, the residence of the marquis of Bute, St Fagan's, near Ely station, and St Donat's and Dunraven, both on the verge of the Bristol Channel. The county has some fine cromlechs at St Nicholas and St Lythan's on the Dyffryn estate, at Cotterell near Peterston; and at Arthur's Stone in Gower. The Sarn Helen, an ancient road, traverses the county. At Llantwit Major, near Cowbridge, was the once famous divinity school founded by St Germanus, and presided over for an incredible term of years by St Iltyd. Every stone in this old-world town is "of old memorial." Coity, Coychurch, and Ewenny, near Bridgend, present a fine trio of cross churches, with fortified or embattled towers, characteristic of the county.

South of Swansea lies the promontory of Gower, famed for the beauty of its coast scenery, its people of Flemish descent, planted here by Henry I., and its bone-caves. The last, in the limestone cliffs, accessible only at low water, are at Bacon Hole, Paviland, and Rhosilly Bay.

Besides its ports, Glamorgan has abundant means of transit in four railways and a canal, beside numerous tramways. The county is divided into 128 parishes and 10 hundreds, and is situated in the diocese of Llandaff. The cathedral, 2 miles from the county town of Cardiff, having fallen into decay through the neglect of ages previous to 1844, owed its restoration to a beauty befitting the prestige of the earliest Christian see to the energetic endeavours of Dean Thomas Williams. It was completed in 1869.

The great changes of recent years in elementary education have curiously affected the statistics of schools in Glamorgan. Whereas in 1847 there were 327 day schools in all, with 15,674 scholars, in 1877 the parliamentary return shows a great reduction in the number of schools, though these have probably a much larger aggregate of scholar. This

return exhibits 226 public elementary schools in Glamorgan, of which 56 were board-schools, 30 British and foreign, 12 Roman Catholic, 1 Wesleyan, and the remainder national, parochial, and Church of England schools. Of these schools, 41 had each in average attendance upwards of 300 scholars, and 2 had upwards of 1000. Fourteen only had night schools in operation. As in other south-west counties, the Welsh language is losing ground, except in remote agricultural districts.

In 1851 the population of the county was 231,849, 120,748 males and 111,101 females; and in 1871 it was 397,859, 205,660 males and 192,199 females. The population has increased since the first census in 1801 by 326,980 persons, or 451 per cent. The county returns two members to parliament, the borough of Merthyr one, and the Cardiff and Swansea districts of boroughs one each, a total of five in all. In the year ending April 1871 the amount of real property assessed to income and property tax was £1,219,922. The principal towns with the populations in 1871 were—

Aberavon ¹	3,574	Llantrisant ²	2,039
Aberdare.....	36,112	Lloughor ¹	1,220
Bridgend.....	3,539	Merthyr Tydvil.....	51,949
Cardiff ²	39,536	Neath ¹	9,319
Cowbridge ²	1,134	Swansea ¹	51,702
Kenfig ¹	591		

The bibliography of the county is stronger in such old chronicles as the *Brut y Tyrcysogion* than in modern researches. Among its important contributions to the *Archæologia Cambrensis* may be mentioned the Rev. H. H. Knight's *Account of Newton Nottage in 1853*; and Dr Thomas Nicholas's *History of the Annals and Antiquities of Glamorganshire* is the foundation of his *Counties and County Families of Wales*. (J. D.A.)

GLANDERS, or EQUINIA, a specific infectious disease to which certain animals, chiefly those possessing an undivided hoof, are liable, and which is communicable from them to man. The term farcy is also employed to designate a variety of this affection, but there is no pathological distinction between the two. The disease as it affects animals belongs to the subject of Veterinary Medicine.

Glanders is happily a rare form of disease in man, there being evidently less affinity for its development in the human subject than in the equine species. It occurs chiefly among those who from their occupation are frequently in contact with horses, such as grooms, coachmen, cavalry soldiers, veterinary surgeons, &c., and seems always produced either by direct inoculation of the virus from a diseased animal into the broken skin, or by the respiration of air containing the poison. It is said to have occasionally been transmitted from man to man, but such an occurrence is extremely rare.

A period of incubation, lasting from three to five days, generally follows the introduction of the virus into the system. This period, however, appears sometimes to be of much longer duration, especially where there has been no direct inoculation of the poison. The first symptoms are a general feeling of illness, accompanied with pains in the limbs and joints resembling those of acute rheumatism. If the disease has been introduced by means of an abraded surface, pain is felt at that point, and inflammatory swelling takes place there, and extends along the neighbouring lymphatics. An ulcer is formed at the point of inoculation which discharges an offensive ichor, and blebs appear in the inflamed skin, along with diffuse abscesses, as in phlegmonous erysipelas. Sometimes the disease stops short with these local manifestations, but more commonly goes on rapidly accompanied with symptoms of grave constitutional disturbance. Over the whole surface of the body there appear numerous red spots or pustules, which break and discharge

¹ Contributory to Swansea parliamentary district of boroughs.

² Contributory to Cardiff parliamentary district of boroughs.

a thick mucous or sanguineous fluid. Besides these there are larger swellings lying deeper in the subcutaneous tissue, which at first are extremely hard and painful, and to which the term farcy "buds" or "buttons" is applied. These ultimately open and become extensive sloughing ulcers.

The mucous membranes participate in the same lesions as are present in the skin, and this is particularly the case with the interior of the nose, where indeed, in many instances, the disease first of all shows itself. This organ becomes greatly swollen and inflamed, while from one or both nostrils there exudes a copious discharge of highly offensive purulent or sanguineous matter. The lining membrane of the nostrils is covered with papules similar in character to those on the skin, which form ulcers, and may lead to the destruction of the cartilaginous and bony textures of the nose. The diseased action extends into the throat, mouth, and eyes, while the whole face becomes swollen and erysipelatous, and the lymphatic glands under the jaws inflame and suppurate. Not unfrequently the bronchial tubes become affected, and cough attended with expectoration of matter similar to that discharged from the nose is the consequence. The general constitutional symptoms are exceedingly severe, and advance with great rapidity, the patient passing into a state of extreme prostration. In the acute form of the disease recovery rarely if ever occurs, and the case generally terminates fatally in a period varying from two or three days to as many weeks.

A chronic form of glanders and farcy is occasionally met with, in which the symptoms, although essentially the same as those above described, advance much more slowly, and are attended with relatively less urgent constitutional disturbance. Cases of recovery from this form are on record; but in general the disease ultimately proves fatal by exhaustion of the patient, or by a sudden supervention, which is apt to occur, of the acute form. On the other hand, acute glanders is never observed to become chronic.

In the treatment of this malady the main reliance is to be placed on the maintenance of the patient's strength by strong nourishment and tonic remedies. If the point of inoculation of the virus can be early made out, its active cauterization, as in the case of any poisoned wound, should be resorted to. The opening of abscesses antiseptically, as well as the use of antiseptic lotions for the affected mucous membranes, is recommended. In all cases of the outbreak of glanders it is of the utmost consequence to prevent the spread of the disease by the destruction of affected animals, and the cleansing and disinfection of infected localities.

GLANVIL, GLANVILL, or GLANVILLE, RANULPH DE (died 1190), the oldest writer on English jurisprudence and chief justiciary of England in the reign of Henry II., was born at Stratford in Suffolk, but in what year is unknown. There is also almost no information regarding his early life. Butterley Abbey was founded by him in 1171. In 1174, along with other barons of Yorkshire, he raised a body of knights to oppose William the Lion, king of Scotland, who had invaded the north of England, and it was he who took the king prisoner at Alnwick. In 1175 he was appointed sheriff of Yorkshire, in 1176 justice of the king's court and a justice itinerant in the northern circuit, and in 1180 chief justiciary of all England. It was under his direction that Henry II. completed his judicial reforms, but the principal of them had been carried out before he came into office. After the death of Henry in 1189 Glanvil was removed from his office by Richard I., and imprisoned till he had paid a ransom, according to one authority, of £15,000. Shortly after obtaining his freedom he joined the order of the cross, and he died at the siege of Acre in 1190. At the instance, it is supposed, of Henry II., Glanvil wrote or superintended the writing of the *Tractatus de legibus et consuetudinibus regni Angliæ*, which is divided

into 14 books, and is chiefly a practical treatise on the forms of procedure in the *curia regis* or king's court, the principles of law involved in these forms being only incidentally referred to. As the source of our knowledge regarding the earliest form of the *curia regis*, and for the information it affords regarding ancient customs and laws, it is of great value to the student of English history. It is now generally agreed that the work of Glanvil is of earlier date than the *Regiam Majestatem*, a work which bears a close resemblance to his. To him is also ascribed the recension of English laws made in the reign of Henry II.

The treatise of Glanvil was first printed in 1554. An English translation, with notes and introduction by John Beames, was published at London in 1812. A MS. copy of a Norman-French translation, made apparently in the reign of King John, is contained in the library of the duke of Northumberland at Alnwick Castle.

GLANVILL, or GLANVIL, JOSEPH (1636–1680), was born at Plymouth in 1636, and was educated at Oxford university, where he graduated as M.A. in 1658. In 1666 he obtained the cure of Abbey Church at Bath; in 1678 he became prebendary of the church of Worcester, and acted as chaplain in ordinary to Charles II. He died at Bath, November 16, 1680, in the forty-fourth year of his age. Glanvill's first work, *The Vanity of Dogmatizing, or Confidence in Opinions, manifested in a Discourse of the shortness and uncertainty of our Knowledge, and its Causes, with Reflexions on Peripateticism, and an Apology for Philosophy*, 1661, is interesting as showing one special direction in which the new method of the Cartesian philosophy might be developed. Pascal had already shown how philosophical scepticism might be employed as a bulwark for faith, and Glanvill follows in the same track. The philosophic endeavour to cognize the whole system of things by referring all events to their causes appears to him to be from the outset doomed to failure. For if we inquire into this causal relation we find that though we know isolated facts, we cannot perceive any such connexion between them as that the one should give rise to the other. In the words of Hume, "they seem conjoined but never connected." All causes then are but secondary, are merely the occasions on which the one first cause operates. It is singular enough that Glanvill who had not only shown, but even exaggerated, the infirmity of human reason, himself paid a strange tribute to its weakness; for, after having combated scientific dogmatism, he not only yielded to vulgar superstitions, but actually endeavoured to accredit them both in his *Scepisis Scientifica*, 1665, and in his *Philosophical Considerations concerning the existence of Sorcerers and Sorcery*, published in 1666, in 4to. The story of the pretended drum, which was said to have been heard every night in the house of an inhabitant of Wiltshire (Mr Mompesson), a story which made much noise in the year 1663, and which is supposed to have furnished Addison with the idea of his comedy of the *Drummer*, appears to have given occasion to the latter work. At his death Glanvill left a piece entitled *Sadducismus Triumphatus*, which was printed in 1681, reprinted with some additions in 1682, and translated into German in 1701. He had there collected twenty-six relations or stories of the same description as that of the drum, in order to establish, by a series of facts, the opinion which he had expressed in his *Philosophical Considerations*. Glanvill supported a much more honourable cause when he undertook the defence of the Royal Society of London, under the title of *Plus Ultra, or the Progress and Advancement of Science since the time of Aristotle*, 1658, a work which shows how thoroughly he was imbued with the ideas of the empirical method as in Bacon. The style of Glanvill is clear, easy, and animated; and to the student of philosophy his works are of considerable interest.