regularity for upwards of thirty years, the only interruptions indeed being that of 1813–14, occasioned by the war of liberation, during which the university was closed, and those occasioned by two prolonged literary tours, first in 1820 to France and England in the society of his colleague Thilo for the examination of rare Oriental manuscripts, and afterwards in 1835 to England and Holland in connexion with his Phœnician studies. At a very early period he became the most popular teacher of Hebrew and of Old Testament introduction and exegesis in Germany; and during his later years the annual number of students attending his lectures on these and kindred subjects, such as church history and Biblical archæology, amounted to nearly 500. Of his pupils many have risen to great eminence in the departments he specially cultivated; among these the names of Von Bohlen, Hoffmann, Hupfeld, Rödiger, Tuch, Vatke, and Benfey may be mentioned. In 1827 Gesenius was made a consistorialrath; but, unless account be taken of the violent attacks to which he, along with his friend and colleague Wegscheider, was in 1830 subjected by Hengstenberg and his party in the *Evangelische Kirchenzeitung*, there are few noteworthy occurrences to be recorded in his biography. His death took place at Halle, October 23, 1842. It would be difficult to overestimate the services rendered by Gesenius to Semitic philology. To him belongs in a large measure the credit of having freed it from the trammels of theological and religious prepossession by which it had previously been hampered, and of inaugurating the strictly scientific method which has since been so fruitful in valuable results. Nor can it be doubted that as an exegete he has exercised a powerful, and on the whole a beneficial, influence on the tendencies of modern theological investigation.

Of his very numerous works the earliest, published in 1810, entitled *Versuch über die Maltesische Sprache*, was a successful refutation of the widely current opinion that the modern Maltese was of Punic origin. In the same year appeared the first volume of the *Hebräisches u. Chaldäisches Handwörterbuch*, completed in 1812 (6th ed., 1878; English translation by Tregelles, 1846–52). The *Hebräische Grammatik*, published in 1813 (32d ed., by Kautzsch, 1878), was followed in 1815 by the *Geschichte der Hebräischen Sprache* (now very rare), and in 1817 by the *Ausführliches Lehrgebäude der Hebräischen Sprache*. The first volume of his well-known commentary on Isaiah (*Der Prophet Jesaja*), with a translation, appeared in 1821; but the work was not completed until 1829. The *Thesaurus philologico-criticus Linguæ Hebraicæ et Chaldaicæ V. T.*, begun in 1829, he did not live to complete; the latter part of the third volume is edited by Rödiger (1858). The other works of Gesenius are *De Pentateuchi Samaritani Origine, Indole, et Auctoritate* (1815), supplemented in 1822 and 1824 by the treatise *De Samaritanorum theologia*, and by an edition of *Carmina Samaritana*; *Paläographische Studien über Phönizische u. Punische Schrift* (1835), a pioneering work which he followed up in 1837 by his collection of Phœnician monuments (*Scripturæ linguæque Phœniciæ monumenta quotquot supersunt*); an Aramaic lexicon (1834–39); and a treatise on the Himyaritic language written in conjunction with Rödiger in 1841. Gesenius also contributed extensively to Ersch and Gruber's *Encyclopädie*, and enriched the German translation of Burckhardt's *Travels in Syria and the Holy Land* with valuable geographical notes. For many years he also edited the Halle *Allgemeine Literaturzeitung*. A well executed sketch of his life was published in 1843 (*Gesenius: eine Erinnerung für seine Freunde*).

GESNER, Johann Matthias (1691–1761), a distinguished German classical scholar, was born at Roth near Ansbach, 9th April 1691. He studied at the university of Jena, and in 1714 published a work on the *Philopatris* ascribed to Lucian. In 1715 he became librarian and conrector at Weimar, in 1729 rector of the gymnasium at Ansbach, and in 1730 rector of the Thomas school at Leipsic, where he had for colleagues Joh. A. Ernesti and Joh. Sebastian Bach. On the foundation of the university of Göttingen he became professor of rhetoric and subsequently librarian also. He died at Göttingen 3d August 1761. His special merit as a classicist is the attention he devoted to the explanation and illustration of the subject matter of the classical authors.

His principal works are editions of the *Scriptores de re rustica*, of Quintilian, Claudian, Pliny the Younger, Horace, and the Orphic poems; *Primæ lineæ isagoges in eruditionem universam*; an edition of Faber's *Thesaurus eruditionis scholastica*, afterwards continued under the title *Novus linguæ et eruditionis Romanæ thesaurus*; *Opuscula varii argumenti*; and *Thesaurus epistolarum Gesneri*. See Ernesti, *Opuscula oratoria*, 1762; and *Göttinger Professoren*, Gotha, 1872.

GESNER, or Gessner, Konrad (1516–1565), a very famous naturalist and author, surnamed the German Pliny and literarum miraculum on account of his vast erudition, was born of poor parents at Zürich, 26th March 1516. He received the first elements of education from Chaplain Frick, his maternal uncle; and it was while gathering plants in his relative's garden that he became imbued with that enthusiastic love of science which remained with him through life. In 1513 he went to Strasburg, then to Bourges, and in 1534 to Paris, studying at all those places with characteristic passionate zeal. In 1535 we find him again in Zürich, where he married somewhat imprudently, for he was very poor, and had no immediate prospect of bettering his condition. His whole day was occupied in teaching, but at least the night was his own, and too great a portion of the time that others give to rest was occupied by Gesner in adding to his already great stock of erudition. In 1537 he was appointed professor of Greek at Lausanne, and in 1541 professor of physics and natural history at Zürich. But in neither of these offices was he well paid, and during those years he wrote a large number of books, partly to support himself, partly from the interest he felt in their subjects. He wrote several works on ancient medicine and on botany, and a treatise on milk (in which he described the rural economy of Switzerland), translated into Latin a Greek logical manual and some works on the moral interpretation of Homer, carefully edited a new edition of *Johannis Stobæi Sententiæ* (Zürich, 1543) and an expurgated edition of Martial (1544), prepared a new edition of the Latin dictionary of Ambrosius Calepinus (Basel, 1544), and wrote besides some lesser dissertations and translations. All this, however, was only mere side work, for in 1545 he issued at Zürich the first part of his justly renowned *Bibliotheca Universalis*, a catalogue of all the works in Latin, Greek, and Hebrew, extant and not extant, published or as yet unpublished. Under each important name there was given a vast mass of bibliographical information and criticism, original and selected. Three years later the second part of this stupendous work appeared, likewise at Zürich, under the title of *Pandectarum sive partitionum universalium Conradi Gesneri Tigurini Libri XXI.* Only nineteen of these books then appeared; the twenty-first, which was a theological encyclopædia, was published in 1549, but the twentieth, which was to contain the medical writings, and which he intended should represent the quintessence of the labours of a lifetime, was never finished and never published.

The next few years were spent in writing small treatises, and in the preparation of another *magnum opus*, a zoological work entitled *Historia Animalium*, which was published in six books (the last of these unfinished) at Zürich between 1551 and 1587. To prepare himself for the worthy execution of this undertaking he read 250 authors, travelled over nearly all Europe, received hints from hosts of learned friends, and did not disdain the information which he obtained from hunters and shepherds. He also made himself a proficient artist, in order that he might by drawings assist his labours. This work contained the names of all known animals in the ancient and modern languages, a description of each as to every important particular, and a mass of interesting literary information, embracing facts and legends regarding them. After this he again occupied himself with lesser writings for some years. He devoted some attention to philology, aided in the preparation of a German-Latin dictionary, and pointed out the force and undreamt-of beauty that lay in that then vulgar and half-developed tongue. But again these and other publications were only secondary labours, for he had a third great work in preparation. He had for some time given great attention to botany, and he now proposed to publish a work on that science corresponding to his great work on zoology. He had made a large collection of materials towards this when his health, never very good, completely gave way. A few hours before his death he desired to be carried into his museum, and there he spent the last moments of life. He died 13th December 1565, not having completed his fiftieth year.

Gesner's intense devotion to science, and his almost incredible powers of acquisition, are seen from the recital of the facts of his biography, and from a mere catalogue of his labours. It deserves to be added that his life was singularly pure and blameless, that his love of knowledge was as disinterested as it was engrossing, that he was always ready and glad to acknowledge any help he received. When obliged to engage in controversy, he did so in a dignified and courteous manner. His medical writings show him to have been far above the silly prejudices of his day. A cheerful and amiable piety was a prominent feature in his character—a character chastened, not soured, by the trials of a hard lifetime.

After Gesner's death his unpublished writings went through a career of vicissitudes not unlike that of their author. A part of them, edited by Professor Schmiedel, was published at Nuremberg in 1753. Other parts followed, but the work was never completed. Lives of Gesner have been written by J. Simmler (Zürich, 1566) and J. Hanhart (Winterthur, 1824). See also Lebert's *Gesner als Arzt* (Zürich, 1854), and Gesner's autobiography in his *Bibliotheca Universalis* (1st ed., p. 180).

GESSNER, Salomon (1730–1788), Swiss painter and poet, and once a very favourite and widely-read author, was born at Zürich 1st April 1730. With the exception of some time spent in Berlin, and a visit to Hamburg undertaken in order to see Hagedorn, he passed the whole of his life in his native town, where he carried on the business of a bookseller. He died 2d March 1788. The first of his writings that attracted attention was his *Lied eines Schweizers an sein bewaffnetes Mädchen* (1751). Then followed *Daphnis* (1754), *Idyllen* (1756), *Inkel and Yariko* (1756), a version of a story already worked out by Gellert and Bodmer, and *Der Tod Abels* (1758), "a sort of idyllic prose pastoral." It is somewhat difficult for us now to understand the reason of Gessner's universal popularity, unless it was the taste of the period for the conventional pastoral. His writings are marked, it is true, by sweetness and melody, but the sweetness soon becomes insipidity, and the melody monotony. He represents in most of his works the existence of shepherds in a golden or rather tinsel age, and nothing more unreal could possibly be imagined. His men and women are inane and lifeless representations. They are all alike, and all equally uninteresting. They never give utterance to any powerful, genuine, human sentiments. Their talk is but meaningless platitude. As a painter Gessner represented "still country scenes, rocks, springs, and waterfalls, shepherds and shepherdesses"—in short, the conventional classical landscape. His son, Konrad Gessner (1764–1826), was also a painter of some reputation.

Collected editions of Gessner's works were repeatedly published (2 vols. 1777–78, finally 2 vols. 1841, both at Zürich). They were translated into French (3 vols., Paris, 1786–93), and versions of the *Idyllen* appeared in English, Dutch, Portuguese, Spanish, Swedish, and Bohemian. Gessner's life was written by Hottinger (Zürich, 1796); see also his *Briefwechsel mit seinem Sohn* (Bern and Zürich, 1801).

GESTA ROMANORUM, a Latin collection of anecdotes and tales, probably compiled about the end of the 13th century or the beginning of the 14th, which still possesses a twofold literary interest, first as one of the most popular books of its time, and secondly as the source, directly or indirectly, of much which has since become current under the stamp of genius. Of its authorship nothing certain is known; and there is little but gratuitous conjecture to associate it either with the name of Helinandus or with that of Petrus Berchorius (Pierre Bercheure). It is even a matter of debate whether it took its rise in England, Germany, or France; while Mr Douce was disposed to give the credit of it to the Germans, Herr Œsterley is inclined to recognize the priority of the English. The work at least was evidently intended as a manual for preachers, and was probably written by one who himself belonged to the clerical profession. The name, *Deeds of the Romans*, is only partially appropriate to the collection in its present form, since, besides the titles from Greek and Latin history and legend, it comprises fragments of very various origin, Oriental and European. The unifying element of the book is its moral purpose: everything is made serviceable for reproof and doctrine, the powerful chemistry of the allegorical method extracting the sunshine of Christian truth from the cucumbers of the most worldly and wicked circumstance. The style is barbarous, and the narrative ability of the compiler seems to vary with his source; but he has managed to bring together a considerable variety of excellent material. He gives us, for example, the germ of the romance of "Guy of Warwick," the story of "Darius and his Three Sons," versified by Occleve, part of Chaucer's "Man of Lawes' Tale," a tale of the emperor Theodosius, the same in its main features as that of *Lear*, the story of the "Three Black Crows," the "Hermit and the Angel," so well-known from Parnell's version, and a story identical with the *Fridolin* of Schiller. Owing to the loose structure of the book, it was easy for a transcriber to insert any additional story into his own copy, and consequently the MSS. of the *Gesta Romanorum* exhibit considerable variety. Œsterley, who has bestowed the fullest investigation on the subject, recognizes an English group of MSS. (written always in Latin), a German group (sometimes in Latin and sometimes in German), and a group which is represented by the vulgate or common printed text. The earliest editions are supposed to be those of Ketelaer and De Lecompt at Utrecht, of Arnold Ter Hoenen at Cologne, and of Ulrich Zell at Cologne; but the exact date is in all three cases uncertain.

An English translation, probably based directly on the MS. Harl. 5369, was published by Wynkyn de Worde about 1510–1515, the only copy of which now known to exist is preserved in the library of St John's College, Cambridge. In 1577 Richard Robinson published a revised edition of Wynkyn de Worde, and the book proved highly popular. Between 1648 and 1703 at least eight impressions were issued. In 1703 appeared the first vol. of a translation by B. P., probably Bartholomew Pratt, "from the Latin edition of 1514." A translation by the Rev. C. Swan, first published in 2 vols. in 1824, forms part of Bohn's Antiquarian Library, and was re-edited by Wynnard Hooper in 1877. The German translation was first printed at Augsburg, 1489. A French version, under the title of *Le Violier des histoires romaines moralisez*, appeared in the early part of the 16th century, and went through a number of editions; it has been reprinted by G. Brunet (Paris, 1858). Critical editions of the Latin text have been produced by A. Keller (Stuttgart, 1842), and Œsterley (Berlin, 1872). See also Warton, "On the Gesta Romanorum," dissertation iii., prefixed to the *History of English Poetry*; Douce, *Illustrations of Shakespeare*, vol. ii.; Frederick Madden, Introduction to the Roxburghe Club edition of *The Old English Versions of the Gesta Romanorum*, 1838.

GETA, Publius Septimus Antoninus (189–212), younger son of the Roman emperor Severus, was born at Milan, 189 A.D. Between him and his brother Caracalla there existed from their early years a keen rivalry and antipathy. On the death of their father in 211 they were,

in accordance with his instructions, proclaimed joint emperors; and after the failure of a proposed treaty by which Caracalla was to retain Europe and western Africa, and Geta Asia and Egypt, Caracalla, on the pretence of a desire for reconciliation, arranged a meeting with his brother in his mother's apartments, and by means of assassins murdered him in her presence (212). His name was obliterated from all public inscriptions; all coins bearing his effigy were to be destroyed; and the use of his name, either in conversation or in writing, was forbidden under pain of death.

GETHSEMANE. See JERUSALEM.

GEULINCX, ARNOLD (1625–1669), one of the most distinguished of the earlier Cartesians, was born at Antwerp in 1625. Few details are known with regard to his life, and his more important works are extremely rare. He studied philosophy and medicine at the university of Louvain, and took there the degree of doctor. For twelve years he continued at the same university as lecturer, and was noted as one of the most successful teachers. For what reason he left is quite uncertain, but he seems to have been obliged to fly from Louvain and to take refuge in Leyden, where he appears to have been in the utmost distress. Only the generous assistance of a friend, by name Heidanus, prevented his death from absolute want of means. At Leyden he entered the Protestant Church, having been previously a Catholic, and it has been supposed that his flight from Louvain was due to doubts excited there as to his orthodoxy. This, however, is merely conjecture. In 1663, through his friend Heidanus, he obtained leave to lecture at Leyden, and devoted himself with the utmost zeal to his new duties. He died in 1669. His most important works were published posthumously. During his lifetime there seem to have been made public only the theses which he defended on graduating at Louvain (*Saturnalia, seu quæstiones quodlibeticæ in utramque partem disputatæ*, 2d ed. 1665). The *Metaphysica vera*, 1691, and the Γνῶθι σεαυτόν, *sive Ethica, post tristia auctoris fata*, 1696 (first part, 1665), are the works by which he is known in the history of philosophy. In addition to these were published *Physica Vera, Logica restituta*, and *Annotata in Principia Philosophiæ R. Cartesii*. Geulincx takes up principally the doctrine, left in an obscure and unsatisfactory state by Descartes, of the relation between soul and body. Extension and thought, the essences of spiritual and corporeal natures, are absolutely distinct, and cannot act upon one another. External facts are not the causes of mental states, nor are mental states the causes of physical facts. So far as the physical universe is concerned, we are merely spectators. The influence we seem by will to exercise over bodies is only apparent; volition and action only accompany one another. I cannot be the author of any state of which I am unconscious, for my very nature is consciousness; but I am not conscious of the mechanism by which bodily motion is produced, hence I am not the author of bodily motion. Body and mind are like two clocks which act together, because at each instant they are adjusted by God. A physical occurrence is but the occasion on which God excites in me a corresponding mental state. Geulincx is thus definitely the originator of the theory called Occasionalism. But the principles on which that theory was founded compelled a further advance. God, who is the cause of the concomitance of bodily and mental facts, is in truth the sole cause in the universe. No fact contains in itself the ground of any other; the existence of the facts is due to God, their sequence and co-existence are also due to him. He is the ground of all that is. My desires or volitions and my thoughts are thus the desires, volitions, or thoughts of God. Apart from God, the finite being has no reality. Geulincx is thus the precursor of Spinoza, and, like Spinoza, he gave out his final results under the title of Ethics. Descartes had left untouched, or nearly so, the difficult problem of the relation between the universal element or thought and the particular desires or inclinations. All these are regarded by Geulincx as modes of the divine thought and action, and accordingly the end of human endeavour is the end of divine will, or the realization of reason. The love of right reason is the supreme virtue, whence flow the cardinal virtues, diligence, obedience, justice, and humility. Liberty is obedience to reason; *nemo servit qui rationi servit*.

Geulincx has not directly touched the problem which evidently must have caused the greatest difficulty to the Cartesians,—how we perceive extended reality,—though he plainly indicates the opinion that we do not perceive it, but have the idea of it from God. He thus carried out to their extreme consequences the irreconcilable elements in the Cartesian metaphysics, and his works have the peculiar value attaching to the vigorous development of a one-sided principle. The abrupt contradictions to which such development leads of necessity compels revision of the principle itself.

See Damiron, *Phil. en France au 17me siecle*, 1846; Bouillier, *His. de la Phil. Cartesienne*, i. ch. 14; Erdmann, *Versuch einer Gesch. d. neu. Phil.*, i., *b.*, sec. 2; Ritter, *Gesch. d. Phil.*, xi. pp. 97–169 (Ritter's account of Geulincx is the fullest in any history of philosophy); K. Fischer, *Gesch. d. neu. Phil.*, i. 2, 11–27.

GEX, a town of France, the chief town of an arrondissement in the department of Ain, is beautifully situated, 2000 feet above sea-level, at the base of the Jura chain on the Journant, 3 miles from the Swiss frontier, and 10 miles N.W. of Geneva. It has tanneries, saw-mills, and corn-mills, and a considerable trade in cheese and wine. The town gives its name to the old *Pays de Gex*, situated between the Alps and the Jura, which was successively under the protection of the Swiss, the Genevese, and the counts of Savoy, until in 1602 it came into the possession of France, retaining, however, until the Revolution its old independent jurisdiction, with Gex as its chief town. The population of the town in 1876 was 1469.

GEYSERS, GEISERS, or GEISIRS, are fountains of a peculiar construction, in virtue of which they shoot up into the air, at more or less regular intervals of time, a column of heated water and steam or of mud. Those of Iceland have been known at least from the time of Saxo Grammaticus, who briefly mentions them in his *Danorum regum historiæ*; but no satisfactory explanation of the phenomena was advanced till near the middle of the present century, when Bunsen brought his scientific knowledge and power of investigation to bear on the subject. Sir George Mackenzie, in his *Travels in Iceland*, 1811, had written as follows:—"Let us suppose a cavity C (fig. 1), communicating with the pipe PQ, filled with boiling water to the height AB, and that the steam above this line is confined so that it sustains the water to the height P. If we suppose a sudden addition of heat to be applied under the cavity C, a quantity of steam will be produced which, owing to the great pressure, will be evolved in starts causing the noises like discharges of artillery, and the shaking of the ground." He admitted that even to his own mind this could be only a partial explanation of the facts of the case, and that he was unable to account for the frequent and periodical production of the necessary heat; but he has the credit of hitting on what is certainly the proximate cause—the sudden evolution of steam. By Bunsen's theory the whole difficulty is solved, as is beautifully demonstrated by the artificial geyser designed by Professor J. H. J. Müller of

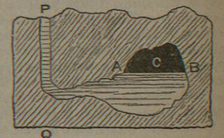

Fig. 1.

Freiburg (fig. 2). If the tube *ab* be filled with water and heated at two points, first at *a* and then at *b*, the following succession of changes is produced. The water at *a* beginning to boil, the superincumbent column is consequently raised, and the stratum of water which was on the point of boiling at *b* being raised to *d* is there subjected to a diminished pressure; a sudden evolution of steam accordingly takes place at *d*, and the superincumbent water is violently ejected. Received in the basin *c*, the air-cooled water sinks back into the tube, and the temperature of the whole column is consequently lowered; but the under strata of water are naturally those which are least affected by the cooling process; the boiling begins again at A, and the same succession of events is the result (see R. Bunsen, "Physikalische Beobachtungen über die hauptsächlichsten Gisire Islands," in *Poggendorff's Annalen der Physik and Chemie*, vol. lxxii., 1847; and J. Müller, "Ueber Bunsen's Geyserntheorie," *ibid.*, vol. lxxix., 1850). The principal difference between the artificial and the natural geyser-tube is that in the latter the effect is not necessarily produced by two distinct sources of heat like the two fires of the experimental apparatus, but by the continual influx of heat from the bottom of the shaft and the differences between the boiling points of the different parts of the column owing to the different pressures of the superincumbent mass. This may be thus illustrated:—AB is the column of water; on the right side the figures represent approximately the boiling points (Fahr.) calculated according to the ordinary laws, and the figures on the left the actual temperature of the same places. Both gradually increase as we descend, but the relation between the two is very different at different heights. At the top the water is still 39° from its boiling point, and even at the bottom it is 19°; but at D the deficiency is only 4°. If, then, the stratum at D be suddenly lifted as high as C, it will be 2° above the boiling point there, and will consequently expend those 2° in the formation of steam.

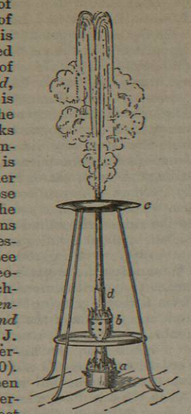

Fig. 2.

Observed.	A	Calculated.
186°		225°
230°		241°
	C	249°
251°		255°
	D	
255°		266°
259°		278°
	B	

Any hot spring capable of depositing siliceous material by the evaporation of its water may in course of time transform itself into a geyser, a tube being gradually built up as the level of the basin is raised. And every geyser continuing to deposit siliceous material is preparing its own destruction; for as soon as the tube becomes deep enough to contain a column of water sufficiently heavy to prevent the lower strata attaining their boiling points, the whole mechanism is deranged. In geyser districts it is easy to find thermal springs busy with the construction of the tube; warm pools, or *laugs*, as the Icelanders call them, on the top of siliceous mounds, with the mouth of the shaft still open in the middle, and dry basins from which the water has receded with their shafts now choked with rubbish.

Geysers exist at the present time in many volcanic regions, as in the Eastern Archipelago, Japan, and South America; but the three localities where they attain their highest development are Iceland, New Zealand, and Wyoming in the United States. The very name by which we call them indicates the historical priority of the Iceland group. It is an old Icelandic word—*geysir*, equivalent to gusher or rager—from the verb *geysa*, itself a derivative of *gjosa*, to gush. In native usage it is the proper name of the Great Geyser, and not an appellative—the general term *hver*, a hot spring, making the nearest approach to the European sense of the word (see Cleasby and Vigfusson, *Icelandic English Dictionary*, s.v.).

The Iceland geysers are situated about 50 miles N.W. of Hecla, in a broad valley of alluvial formation, at the foot of a range of hills from 300 to 400 feet in height. Within a circuit of about two miles, upwards of one hundred hot springs may be counted, varying greatly both in character and dimensions. The Great Geyser in its calm periods appears as a circular pool 72 feet in diameter and 4 feet in depth, occupying a basin on the summit of a mound of siliceous concretion; and in the centre of the basin is a shaft, about 9 feet in diameter and 70 feet in depth, lined with the same siliceous material. The clear sea-green water flows over the eastern rim of the basin in little runnels. On the surface it has a temperature of from 76° to 89° Cent., or from 168° to 188° Fahr. Within the shaft there is of course a continual shifting both of the average temperature of the column and of the relative temperatures of the several strata. The results of the observations of Bunsen and Descloizeaux in 1874 were as follows (*cf. Poggendorff's Annalen*, loc. cit., and *Comptes Rendus*, vol. xxiii.):—About three hours after a great eruption on July 6th, the temperature 6 metres from the bottom of the shaft was 121·6° C.; at 9·50 metres, 121·1°; at 16·30 metres, 109° (!); and at 19·70 metres, 95° (!). About nine hours after a great eruption on July 6th, at about 0·3 metres from the bottom, it was 123°; at 4·8 metres it was 122·7°; at 9·6 metres, 113°; at 14·4 metres, 85·8°; at 19·2 metres, 82·6°. On the 7th, there having been no eruption since the previous forenoon, the temperature at the bottom was 127·5°; at 5 metres from the bottom, 123°; at 9 metres, 120·4°; at 14·75 metres, 106·4°; and at 19 metres, 55°. About three hours after a small eruption, which took place at forty minutes past three o'clock in the afternoon of the 7th, the temperature at the bottom was 126·5°; at 6·85 metres up it was 121·8°; at 14·75 metres, 110°; and at 19 metres, 55°. Thus, continues Bunsen, it is evident that the temperature of the column diminishes from the bottom upwards, that, leaving out of view small irregularities, the temperature in all parts of the column is found to be steadily on the increase in proportion to the time that has elapsed since the previous eruption; that even a few minutes before the great eruption the temperature at no point of the water column reached the boiling point corresponding to the atmospheric pressure at that part; and finally, that the temperature about half-way up the shaft made the nearest approach to the appropriate boiling point, and that this approach was closer in proportion as an eruption was at hand. Observations made by Mr Robert Walker in August 1874 remarkably confirm those of Professor Bunsen (see *Proceedings of Roy. Soc. of Edinburgh*, vol. viii. p. 514). The Great Geyser has varied very much in the nature and frequency of its eruptions since it began to be observed. In 1809 and 1810, *e.g.*, according to Hooker and Mackenzie, its columns were 100 or 90 feet high, and rose at intervals of 30 hours, while, according to Henderson, in 1815 the intervals were of 6 hours, and the altitude from 80 to 150 feet.

About 100 paces from the Great Geyser is the *Strokkr* or churn, which was first described by Stanlay in 1789. The shaft in this case is about 44 feet deep, and, instead of being cylindrical, is funnel-shaped, having a width of

about 8 feet at the mouth, but contracting to about 10 inches near the centre. By casting stones or turf into the shaft so as to stopper the narrow neck, eruptions can be accelerated, and they often exceed in magnitude those of the Great Geyser itself.[1] During quiescence the column of water fills only the lower part of the shaft, its surface usually lying from 9 to 12 feet below the level of the soil. Unlike that of the Great Geyser, it is always in ebullition, and its temperature is subject to comparatively slight differences. On the 8th of July 1847 Bunsen found the temperature at the bottom 112·9° C.; at 3 metres from the bottom, 111·4°; and at 6 metres, 108°; the whole depth of water was on that occasion 10·15 metres. On the 6th, at 2·90 metres from the bottom, it was 114·2°; and at 6·20 metres, 109·3°. On the 10th, at 0·35 metres from the bottom, the reading gave 113·9°; at 4·65 metres, 113·7°; and at 8·85 metres, 99·9°.

The great geyser-district of New Zealand is situated in the south of the province of Auckland in or near the upper basin of the Waikato river to the N.E. of Lake Taupo. In many respects the scene presented in various parts of the districts is far more striking and beautiful than anything of the same kind to be found in Iceland, but this is due not so much to the grandeur of the geysers proper as to the bewildering profusion of boiling springs, steam-jets, and mud-volcanoes, and to the fantastic effects produced on the rocks by the siliceous deposits and by the action of the boiling water. At Whakarewarewa, near Lake Loto Rua, there is a group of eight geysers, one of which, the Waikate, throws the column to a height of 30 or 35 feet (see Hochstetter, *New Zealand*, 1867). But it is in the Yellowstone Park, in the north-west corner of Wyoming, that the various phenomena of the geysers can be observed on the most portentous scale. The geysers themselves are to be counted by hundreds, and the dimensions and activity of several of them render those of Iceland and New Zealand almost insignificant in comparison. The principal groups are situated along the course of that tributary of the Upper Madison which bears the name of Fire Hole River. Many of the individual geysers have very distinctive characteristics in the form and colour of the mound, in the style of the eruption, and in the shape of the column. The "Giantess," as observed by Langford (1870) and Dunraven (1874), lifts the main column to a height of only 50 or 60 feet, but shoots a thin spire to no less than 250 feet. The "Castle" varies in height from 10 or 15 to 250 feet; and on the occasions of greatest effort the noise is appalling, and shakes the ground like an earthquake. Strong distinct pulsations, says Lord Dunraven, occurred at a maximum rate of seventy per minute, having a general tendency to increase gradually in vigour and rapidity until the greatest development of strength was attained, and then sinking again by degrees. The jets grew stronger and stronger at every pulsation for ten or twelve strokes, until the effort would culminate in three impulses of unusual power. The total display lasted about an hour. "Old Faithful" owes its name to the regularity of its action. Its eruptions, which raise the water to a height of 100 or 150 feet, last for about five minutes, and recur every three-quarters of an hour. The "Beehive" sometimes attains a height of 219 feet; and the water, instead of falling back into the basin, is dissipated in spray and vapour. Very various accounts are given of the "Giant." Hayden saw it playing for an hour and twenty minutes, and reaching a height of 140 feet, and Lieutenant Doane says it continued in action for three hours and a half, and had a maximum of 200 feet; but at the earl of Dunraven's visit the eruption lasted only a few minutes. For further details see Dunraven's *Great Divide* (1874), and the *Reports* of Professor Hayden.

[1] According to Professor Tyndall (see *Royal Institution Notices*, 1853, and *Heat as a Mode of Motion*, 1863), this effect of the stopper is simply due to the fact that it is an impediment to the normally gradual ascent of the heated aqueous strata, and that it is an impediment which at last is suddenly removed.

GEZER (גֶּזֶר), a royal Canaanite city on the boundary of Ephraim in the maritime plain (Josh. xvi. 3–10). It was allotted to the Levites, but its original inhabitants were not driven out until the time of Solomon, when the Egyptians took the city, which was given to Solomon's wife (1 Kings ix. 16). Under the form Gazera it is mentioned as being in the neighbourhood of Emmaus-Nicopolis ('Amwâs) and Jamnia (Yebnah) (1 Macc. iv. 15). Throughout the history of the Maccabean wars Gazera plays the part of an important frontier post. It was first taken from the Greeks by Simon the Asmonean (1 Macc. xiv. 7). Josephus also mentions that the city was "naturally strong" (*Antiq.*, viii. 6, 1). The position of Gezer is defined by Jerome (*Onomasticon*, s.v.) as 4 Roman miles north (contra septentrionem) of Nicopolis ('Amwâs). This points to the ruined site called *Tell Jezer*, near the village of Abu Shûsheh, about 4 miles north-west of 'Amwâs. The site is naturally very strong, the town standing on an isolated hill, commanding the western road to Jerusalem just where it begins to enter the mountains of Judah. The name Gezer (from a root signifying "insulated") was no doubt derived from the position of the place. The ruins include rock-cut tombs, wine-presses, caves, and quarries, with foundations of a citadel on the hill top. A very fine spring ('Ain Yerdeh) exists on the east, and in 1874 a curious discovery was made on the hill side near the spring. The words Tahum Gezer, "boundary of Gezer," were found cut in Hebrew letters on the live rock in two places, and in each case the Greek name Alkios occurred with them. The genuineness of this curious inscription has not been disputed.

GFRÖRER, August Friedrich (1803–1861), historian, was born at Calw, Würtemberg, on the 5th of March 1803, and at the close of his preliminary studies at the seminary of Blaubeuren, entered the university of Tübingen in 1821 as a student of evangelical theology. After passing his final examinations in 1825, he spent a year in Switzerland, during part of which time he acted as companion and secretary to Bonstetten; the year 1827 was spent chiefly in Rome. Returning to Würtemberg in 1828, he first undertook the duties of repetent or theological tutor in Tübingen and afterwards accepted a curacy in Stuttgart; but having in 1830 received an appointment in the royal public library at Stuttgart, he thenceforth gave himself exclusively to literature and historical science. His first work on Philo (*Philo u. die jüdisch-alexandrinische Theosophie*, 1831) was rapidly followed by an elaborate biography, in two volumes, of Gustavus Adolphus (*Gustav Adolf, König von Schweden*, 1835–37), and by a critical history of primitive Christianity (*Kritische Geschichte des Urchristenthums*, 1838), in three volumes, consisting of three parts, entitled respectively "The Century of Salvation" (*Jahrhundert des Heils*), "Sacred Legend" (*Die heilige Sage*), and "Truth" (*Die Wahrheit*). In both of the last-named works, Gfrörer had manifested opinions unfavourable to Protestantism, which, however, were not openly avowed until fully developed in his church history (*Allgemeine Kirchengeschichte bis Beginn des 14ten Jahrhunderts*, 1841–46). In the autumn of 1846 he was appointed to the chair of history in the university of Freiburg, where he continued to teach until his death, which took place at Carlsbad on the 10th of July 1861. In 1848 he sat as a representative in the Frankfort parliament, where he supported the "High German" party, and in 1853 he publicly went over to the Church of Rome, influenced, however, in this, it is said, more by regard for what he conceived to be its political value, than by any purely religious consideration. Among his later works the most important is the *Geschichte der ost- u. westfränkischen Karolinger* (1858); but those on the pseudo-Isidorian Decretals (*Untersuchung über Alter, Ursprung, u. Werth der Decretalen des falschen Isidorus*, 1848), on the primitive history of mankind (*Urgeschichte des menschlichen Geschlechts*, 1855), on Hildebrand (*Papst Gregor VII. u. sein Zeitalter*, 1859–61), on the history of the 18th century (*Geschichte des 18ten Jahrhunderts*, 1862–73), on German popular rights (*Zur Geschichte deutscher Volksrechte*, 1866), and on Byzantine history (*Byzantinische Geschichte*, 1872–74), are also works of real value. The fruit of much original research, they convey a great quantity of fresh information, and are unusually rich in suggestion; their chief fault may be said to lie in an excess of ingenuity, which leads their author to imagine combinations which never existed, and to invent the most recondite causes for historical occurrences, the explanation of which is rather to be sought in the region of the obvious.

GHÂTS, or Ghauts (literally "the Landing Stairs" from the sea, or "Passes"), two ranges of mountains extending along the eastern and western shores of the Indian peninsula. The *Eastern Ghâts* run in fragmentary spurs and ranges down the Madras coast. They commence in the Orissa district of Balasor, pass southwards through Cuttack and Purí, enter the Madras presidency in Ganjám, and sweep southwards through the districts of Vizagapatam, Godávari, Nellore, Chengalpat, South Arcot, Trichinopoli, and Tinnevelly. They run at a distance of from 50 to 150 miles from the coast, except in Ganjám and Vizagapatam, where in places they almost abut on the Bay of Bengal. Their geological formation is granite, with gneiss and mica slate, with clay slate, hornblende, and primitive limestone overlying. The average elevation is about 1500 feet, but several hills in Ganjám are between 4000 and 5000 feet. The *Western Ghâts* start from the north of the Tápti valley, and run south through Khándesh, Násik, Tanna, Satara, Ratnagiri, Kanara, and Malabar, and the states of Cochin and Travancore, meeting the Eastern Ghâts at an angle near Cape Comorin. The range of the Western Ghâts extends uninterruptedly, with the exception of a gap or valley 20 miles across known as the Palghát gap. The length of the range is 800 miles from the Tápti to the Palghát gap, and south of this about 200 miles to the extreme south of the peninsula. In many parts there is only a narrow low strip of coast between the hills and the shore; at one point they rise in magnificent precipices and headlands out of the ocean. The average elevation is 3000 feet, precipitous on the western side facing the sea, but with a more gradual slope on the east to the plains below. The highest peaks in the northern section are Mahábaleswar, where is the summer capital of the Government of Bombay, 4700 feet; Purandhar, 4472; and Sinhgarh, 4162 feet. South of Mahábaleswar the elevation diminishes to about 1000 feet above sea-level. Further south the elevation again increases, and attains its maximum towards Coorg, where the highest peaks vary from 5500 to 7000 feet, and where the main range joins the interior Nilgiri hills. South of the Palghát gap, the peaks of the Western Ghâts rise as high as 7000 feet. The geological formation is trap in the northern and laterite in southern section.

GHÁZIÁBÁD, a town in Meerut district, North-Western Provinces of India, distant 12 miles from Delhi and 28 miles from Meerut, in 28° 39′ 55″ N. lat., 77° 28′ 10″ E. long. The town was founded in 1740 by Ghází-ud-dín, brother of Nawáb Salábat Jang, ruler of the Deccan, and takes its name from its founder. It has considerably risen in importance of late years, from having been selected as the point of junction of the East Indian, and the Sind, Punjab, and Delhi railways. A branch into Delhi city diverges from Gháziábád. Population (1872) 7365.

GHÁZÍPUR, a district of British India, in the lieutenant-governorship of the North-Western Provinces, and included in the Benares division. It is bounded on the N. by Azimgarh and Sáran, E. by Sáran, S. by Sháhábád, and W. by Benares and Jaunpur. Gházipur forms part of the great alluvial plain of the Ganges, which divides it into two unequal portions. The northern subdivision lies between the Gumtí and the Gográ, whose confluences with the main stream mark its eastern and western limits respectively. The southern tract is a much smaller strip of country, enclosed between the Karamnása and the great river itself. No hill or natural eminence is to be found in the district. A few lakes are scattered here and there, formed where the rivers have deserted their ancient channels. The largest is that of Suráha, once a northern bend of the Ganges, but now an almost isolated sheet of water, 5 miles long by about 4 broad.

Gházípur is a closely cultivated district, and out of a total area of 2168 square miles 1546 are actually under cultivation. The harvests are the same as those common to the whole of the plain districts of the North-Western Provinces. The census of 1872 returned a total population in Gházipur district of 1,345,570 souls (males 696,572, females 648,829), dwelling in 3725 villages or townships, and inhabiting 285,007 houses. The Hindus numbered 1,221,810, or 90·7 per cent., and Mahometans, 123,455. Of the three higher Hindu castes there were — Bráhmans, 123,012; Rajputs, 295,355; and Baniyás, 49,538. The lower castes are represented by the Ahírs, 171,216; Chámárs, 122,075; Káyasths, 22,480; and Kurmís, 18,136. Amongst the Mussulmans, the Shaikhs numbered 26,940; Sayyids, 4525; Mughals, 570; and Pathâns, 18,452. The district is rich, and in the eastern parts the soil is extremely fertile, so that the cultivators are, on the whole, in easy circumstances. Sixteen towns contain a population exceeding 5000, viz., Gházipur, 38,853; Mahatwar Khás, 8975; Shiupur Diar, 9279; Gahmar, 9050; Sherpur, 7958; Riotipur, 9323; Bára, 5424; Chit, 5821; Narhi, 5527; Bansdih, 7319; Bioti, 7700; Maniar, 5285; Ballia, 8521; Bairia, 5589; Sonbarsa, 7162; and Rasra, 7261. The chief imports into the district are English piece goods and thread, cotton, salt, spices, and grain; the principal exports, country cloth, sugar, fuller's earth, oil seeds, and hides. The headquarters of the Government opium manufacture is at Gházipur town. Carbonate of soda is manufactured from the *reh* or saline efflorescence of the barren usar plains, and largely exported. Saltpetre is also largely prepared from the same source. The great trade route is the Ganges, but good roads connect all the principal centres with each other. The East Indian Railway runs for 24 miles through the district, with stations at Zamániah, Dildarnagar, and Gahmar. The total amount of imperial, local, and municipal revenue of the district in 1876 was £200,000. Gházipur is said to be one of the hottest and dampest districts in the North-Western Provinces. In 1869 the annual mean temperature was 80° Fahr., the lowest monthly mean being 61° Fahr., in January, and the highest 98°, in May. The average total rainfall for 11 years from 1860 to 1871 was 40·1 inches, the maximum being 50·5 inches, in 1861, and the minimum 21·5 inches, in 1868.

GHÁZIPUR Town, the capital of the district, stands on the low alluvial northern bank of the Ganges, in 35° 23′ 36″ N. lat. and 83° 35′ 13″ E. long., covering an area of 416 acres, and with a population in 1872 of 38,853. There is considerable trade in sugar, tobacco, long cloth, and rose water. It is the headquarters of the Government opium department, where all the opium from the North-Western Provinces is collected and manufactured under a monopoly. A metalled road runs from Gházípur to Zamániah station on the East Indian Railway, 13½ miles. Lord Cornwallis, the governor-general of India, died at Gházípur in 1805, and a monument and marble statue are erected over his grave.

GHAZNI (called in European books often Ghaznah, Gazna, Ghizni, or Ghuznee, in the Oriental histories more generally Ghaznín), a famous city in Afghanistan, the seat of an extensive empire under two different mediæval dynasties, and again of prominent interest in the modern history of British India. Ghazni stands on the high table-land of central Afghanistan, in 68° 20′ E. long., 33° 34′ N. lat., at a height of 7726 feet above the sea, and on the direct road between Kandahar and Cabul, 233 miles by