

is full, but badly arranged and edited. Of numerous editions of individual works, or portions of the whole, the following are good:—*Œuvres Philosophiques de Bacon*, par Bouillet, 3 vols., 1834; *Essays*, by Whately, 5th ed., 1866, and by W. A. Wright, 1862; *Novum Organum*, by Kitchin (1855); Translation by the same (1855); *Advancement of Learning*, by W. A. Wright. *Philosophy*.—Besides the Introductions in Ellis and Spedding's edition, the following may be noticed:—Kuno Fischer, *Franz*

BACON, JOHN, who may be considered the founder of the British school of sculpture, was born Nov. 24, 1740. He was the son of Thomas Bacon, cloth-worker in Southwark, whose forefathers possessed a considerable estate in Somersetshire. At the age of fourteen he was bound apprentice in Mr Crispe's manufactory of porcelain at Lambeth, where he was at first employed in painting the small ornamental pieces of china, but by his great skill in moulding he soon attained the distinction of being modeller to the work. The produce of his labour he devoted to the support of his parents, then in somewhat straitened circumstances. While engaged in the porcelain works he had an opportunity of seeing the models executed by different sculptors of eminence, which were sent to be buried at an adjoining pottery. An observation of these productions appears to have immediately determined the direction of his genius; he devoted himself to the imitation of them with so much success, that in 1758 a small figure sent by him to the Society for the Encouragement of Arts received a prize, and the highest premiums given by that society were adjudged to him nine times between the years 1763 and 1776. During his apprenticeship he also improved the method of working statues in artificial stone, an art which he afterwards carried to perfection. Bacon first attempted working in marble about the year 1763, and, during the course of his early efforts in this art, was led to improve the method of transferring the form of the model to the marble (technically called *getting out the points*), by the invention of a more perfect instrument for the purpose, which has since been adopted by many sculptors both in this and other countries. This instrument possesses many advantages above those formerly employed; it is more exact, takes a correct measurement in every direction, is contained in a small compass, and can be used upon either the model or the marble. In the year 1769 he was adjudged the first gold medal given by the Royal Academy, and in 1770 was made an associate of that body. He shortly afterwards exhibited a figure of Mars, which gained him considerable reputation, and he was then engaged to execute a bust of George III., intended for Christ Church, Oxford. He secured the king's favour, and retained it throughout life. His great celebrity now procured him numerous commissions, and it is said, that of sixteen different competitions in which he was engaged with other artists, he was unsuccessful in one case only. Considerable jealousy was entertained against him by other sculptors, and he was commonly charged with ignorance of classic style. This charge he repelled by the execution of a noble head of Jupiter Tonans, and many of his emblematical figures are in perfect classical taste. On the 4th of August 1799, he was suddenly attacked with inflammation, which occasioned his death in little more than two days, in the 59th year of his age. He left a widow, his second wife, and a family of six sons and three daughters. Of his merit as a sculptor, the universal reputation of his works affords decisive proof; and his various productions which adorn St. Paul's Cathedral, London, Christ Church and Pembroke College, Oxford, the Abbey Church, Bath, and Bristol Cathedral, give ample testimony to his powers. Perhaps his best works are to

Bacon und seine Nachfolger, 2d ed., 1875 (1st ed., 1856, trans. into English by Oxenford, 1857); Rémusat, *Bacon, sa vie, &c.*, 1857 (2d ed., 1858); Craik, *Bacon, his Writings and his Philosophy*, 3 vols. 1846-7 (new ed., 1860); A. Dörner, *De Baconis Philosophia*, Berlin, 1867; Liebig, *Ueber Francis Bacon von Verulam und die Methode der Naturforschung*, 1863; Lasson, *Ueber Bacon von Verulam's wissenschaftliche Principien*, 1860; Böhmer, *Ueber P. Bacon von Verulam*, 1864. (R. AD.)

be found among the monuments in Westminster Abbey. (See *Memoir of the late John Bacon, R.A.*, by the Rev. Richard Cecil: London, 1811.)

BACON, SIR NICHOLAS, lord keeper of the great seal in the reign of Queen Elizabeth, was born at Chislehurst in Kent in 1510, and educated at the university of Cambridge, after which he travelled in France, and made some stay at Paris. On his return he settled in Gray's Inn, and applied himself with such assiduity to the study of the law, that he quickly distinguished himself; and, on the dissolution of the monastery of St Edmund's Bury in Suffolk, he obtained a grant of several manors from King Henry VIII., then in the thirty-sixth year of his reign. Two years later he was promoted to the office of attorney in the court of wards, which was a place of both honour and profit. In this office he was continued by King Edward VI.; and in 1552 he was elected treasurer of Gray's Inn. His great moderation and prudence preserved him through the dangerous reign of Queen Mary. Very early in the reign of Elizabeth he was knighted; and in 1558 he succeeded Nicholas Heath, archbishop of York, as keeper of the great seal of England; he was at the same time made one of the queen's privy council. As a statesman, he was remarkable for the clearness of his views and the wisdom of his counsels, and he had a considerable share in the settling of ecclesiastical questions. That he was not unduly elated by his preferments, appears from the answer he gave to Queen Elizabeth when she told him his house at Redgrave was too little for him, "Not so, madam," returned he, "but your majesty has made me too great for my house." On only one occasion did he partially lose the queen's favour. He was suspected of having assisted Hales, the clerk of the hanaper, in his book on the succession, written at the time of Lady Catherine Grey's unjust imprisonment. Bacon was deprived of his seat at the council, and it was even contemplated to deprive him of the seal also. He seems, however, to have quickly regained his position, and to have stood as high in the royal favour as before. He died on the 26th of February 1579, having held the great seal more than twenty years, and was buried in St Paul's, London, where a monument, destroyed by the great fire of London in 1666, was erected to his memory. Granger observes that he was the first lord keeper who ranked as lord chancellor; and that he had much of that penetrating genius, solidity, judgment, persuasive eloquence, and comprehensive knowledge of law and equity, which afterwards shone forth with such splendour in his illustrious son.

BACON, ROGER. The 13th century, an age peculiarly rich in great men, produced few, if any, who can take higher rank than Roger Bacon. He is in every way worthy to be placed beside such thinkers as Albertus Magnus, Bonaventura, and Thomas Aquinas. These had an infinitely wider renown in their day, while he was ignored by his contemporaries and neglected by his successors; but modern criticism has restored the balance in his favour, and is even in danger of going equally far in the opposite direction. Bacon, it is now said, was not appreciated by his age because he was so completely in advance of it; he is a 16th or 17th century philosopher, whose lot has been by some accident cast in the 13th century; he

is no schoolman, but a modern thinker, whose conceptions of science are more just and clear than are even those of his more celebrated namesake.¹ In this view there is certainly a considerable share of truth, but it is much exaggerated. As a general rule, no man can be completely dis severed from his national antecedents and surroundings, and Bacon is not an exception. Those who take up such an extreme position regarding his merits have known too little of the state of contemporary science, and have limited their comparison to the works of the scholastic theologians. (We never find in Bacon himself any consciousness of originality; he has no fresh creative thought or method to introduce whereby the face of science may be changed; he is rather a keen and systematic thinker, who is working in a well-beaten track, from which his contemporaries were being drawn by the superior attractions of theology and metaphysics.)

Roger Bacon was born in 1214, near Ilchester, in Somersetshire. His family appears to have been in good circumstances, for he speaks of his brother as wealthy, and he himself expended considerable sums on books and instruments; but in the stormy reign of Henry III. they suffered severely, their property was despoiled, and several members of the family were driven into exile. Roger completed his studies at Oxford, though not, as current traditions assert, at Merton or at Brazenose, neither of those colleges having then been founded. His great abilities were speedily recognised by his contemporaries, and he came to be on terms of close intimacy with some of the most independent thinkers of the time. Of these the most prominent were Adam de Marisco and Robert Grosseteste (*Capito*), afterwards bishop of Lincoln, a man of liberal mind and wide attainments, who had especially devoted himself to mathematics and experimental science.

Very little is known of Bacon's life at Oxford; it is said he took orders in 1233, and this is not improbable. In the following year, or perhaps later, he crossed over to France, and studied for a considerable length of time at the university of Paris, then the centre of intellectual life in Europe. The years Bacon spent there were unusually stirring. The two great orders, the Franciscans and Dominicans, were in the vigour of youth, and had already begun to take the lead in theological discussion. Alexander of Hales, the author of the great *Summa*, was the oracle of the Franciscans, while the rival order rejoiced in Albertus Magnus, and in the rising genius of the angelic doctor, Thomas Aquinas.

The scientific training which Bacon had received, partly by instruction, but more from the study of the Arab writers, made patent to his eyes the manifold defects in the imposing systems reared by these doctors. It disgusted him to hear from all around him that philosophy was now at length complete, that it had been reduced into compact order, and was being set forth by a certain professor at Paris. Even the great authority on which they reposed, Aristotle, was known but in part, and that part was rendered well-nigh unintelligible through the vileness of the translations; yet not one of those professors would learn Greek so that they might arrive at a real knowledge of their philosopher. The Scriptures, if read at all in the schools, were read in the erroneous versions; but even these were being deserted for the *Sentences* of Peter Lombard. Physical science, if there was anything deserving that name, was cultivated, not by experiment in the true Aristotelian way, but by discussion and by arguments deduced from premises resting on authority or custom. Everywhere there was a show of knowledge covering and concealing fundamental ignorance. Bacon, accordingly, who knew what true science was, and who had glimpses of a scientific organon or method, withdrew from the usual

scholastic routine, and devoted himself to languages and experimental researches. Among all the instructors with whom he came in contact in Paris, only one gained his esteem and respect; this was an unknown individual, Petrus de Maharncuria Picardus, or of Picardy, probably identical with a certain mathematician, Petrus Peregrinus of Picardy, who is perhaps the author of a MS. treatise, *De Magnete*, contained in the Bibliothèque Impériale at Paris. The contrast between the obscurity of such a man and the fame enjoyed by the fluent young doctors of the schools seems to have roused Bacon's indignation. In the *Opus Minus* and *Opus Tertium* he pours forth a violent tirade against Alexander of Hales, and against another professor, not mentioned by name, but spoken of as alive, and blamed even more severely than Alexander. This anonymous writer, he says, who entered the order when young (*puerulus*), who had received no proper or systematic instruction in science or philosophy, for he was the first in his order to teach such subjects, acquired his learning by teaching others, and adopted a dogmatic tone, which has caused him to be received at Paris with applause as the equal of Aristotle, Avicenna, or Averroes. He has corrupted philosophy more than any other; he knows nothing of optics or perspective, and yet has presumed to write *de naturalibus*; he is ignorant of speculative alchemy, which treats of the origin and generation of things; he, indeed, is a man of infinite industry, who has read and observed much, but all his study is wasted because he is ignorant of the true foundation and method of science.²

It is probable that Bacon, during his stay in Paris, acquired considerable renown. He took the degree of doctor of theology, and seems to have received from his contemporaries the complimentary title of *doctor mirabilis*. In 1250 he was again at Oxford, and probably about this time, though the exact date cannot be fixed, he entered the Franciscan order. His fame spread very rapidly at Oxford, though it was mingled with suspicions of his dealings in magic and the black arts, and with some doubts of his orthodoxy. About 1257, Bonaventura, general of the order, interdicted his lectures at Oxford, and commanded him to leave that town and place himself under the superintendence of the body at Paris. Here for ten years he remained under constant supervision, suffering great privations, and strictly prohibited from writing anything which might be published. But during the time he had been at Oxford his fame had reached the ears of the Papal legate in England, Guy de Foulques, a man of culture and scientific tastes, who in 1265 was raised to the papal chair as Clement IV. In the following year he wrote to Bacon, who had been already in communication with him, ordering him, notwithstanding

¹ It is difficult to identify this unknown professor. Brewer thinks the reference is to Richard of Cornwall; but the little we know of Richard is not in harmony with what is said here, nor with the terms in which he is elsewhere spoken of by Bacon. Erdmann conjectures Thomas Aquinas, which is extremely improbable, as Thomas was unquestionably not the first of his order to study philosophy. Cousin and Charles think that Albertus Magnus is aimed at, and certainly much of what is said applies with peculiar force to him. But some things do not at all cohere with what is otherwise known of Albert. The unknown is said to have received no regular philosophic training; we know that Albert did. The unknown entered the order when very young; unless the received date of Albert's birth be false, he did not enter till nearly twenty-eight years of age. Albert, too, could not be said with justice to be utterly ignorant of alchemy, and his mechanical inventions are well known. It is worth pointing out that Brewer, in transcribing the passage bearing on this (*Op. Ined.* p. 327), has the words *Fraterum puerulus*, which in his marginal note he interprets as applying to the Franciscan order. In this case, of course, Albert could not be the person referred to, as he was a Dominican. But Charles, in his transcription, entirely omits the important word *Fraterum*. There are other instances in which Brewer and Charles do not agree, e.g., according to Brewer, Bacon speaks of Thomas and Albert as *pueri duorum ordinum*; according to Charles, he says, *primi duorum ordinum*; a discrepancy not unimportant.

² See Dühring, *Kritische Ges. d. Phil.* 192, 249-51.

any injunctions from his superiors, to write out and send to him a treatise on the sciences which he had already asked of him when papal legate. Bacon, who in despair of being ever able to communicate his results to the world, had neglected to compose anything, and whose previous writings had been mostly scattered tracts, *capitula quedam*, took fresh courage from this command of the Pope. Relying on his powerful protection, he set at naught the many obstacles thrown in his way by the jealousy of his superiors and brother friars, and despite the want of funds, instruments, materials for copying, and skilled copyists, completed in about eighteen months three large treatises, the *Opus Majus*, *Opus Minus*, and *Opus Tertium*, which, with some other tracts, were despatched to the Pope by the hands of one Joannes, a young man trained and educated with great care by Bacon himself.

The composition of such extensive works in so short a time is a marvellous feat. We do not know what opinion Clement formed of them, but before his death he seems to have bestirred himself on Bacon's behalf, for in 1268 the latter was released and permitted to return to Oxford. Here he continued his labours in experimental science, and also in the composition of complete treatises. The works sent to Clement he regarded as mere preliminaries, laying down principles which were afterwards to be applied to the several sciences. The first part of an encyclopædic work probably remains to us in the *Compendium Studii Philosophiæ*, belonging to the year 1271. In this work Bacon makes a vehement attack upon the ignorance and vices of the clergy and monks, and generally upon the insufficiency of the existing studies. In 1278 he underwent the punishment which seems to have then been the natural consequence of outspoken opinions. His books were condemned by Jerome de Ascoli, general of the Franciscans, a gloomy bigot, who afterwards became Pope, and the unfortunate philosopher was thrown into prison, where he remained for fourteen years. During this time, it is said, he wrote the small tract *De Retardandis Senectutis Accidentibus*, but this is merely a tradition. In 1292, as appears from what is probably his latest composition, the *Compendium Studii Theologiæ*, he was again at liberty. The exact time of his death cannot be determined; 1294 is probably as accurate a date as can be fixed upon.

Bacon's Works.—Leland has said that it is easier to collect the leaves of the Sibyl than the titles of the works written by Roger Bacon; and though the labour has been somewhat lightened by the publications of Brewer and Charles, referred to below, it is no easy matter even now to form an accurate idea of his actual productions. His writings, so far as known to us, may be divided into two classes, those yet in manuscript and those printed. An enormous number of MSS. are known to exist in British and French libraries, and probably all have not yet been discovered. Many are transcripts of works or portions of works already published, and therefore require no notice. Of the others, several are of first-rate value for the comprehension of Bacon's philosophy, and, though extracts from them have been given by Charles, it is clear that till they have found an editor, no representation of his philosophy can be complete.¹

The works hitherto printed (neglecting reprints) are the following:—(1.) *Speculum Alchimie*, 1541—translated into English, 1597; (2.) *De Mirabili Potestate Artis et*

¹ The more important MSS. are:—(1.) The extensive work on the fundamental notions of physics, called *Communio Naturalium*, which is found in the Mazarin Library at Paris, in the British Museum, and in the Bodleian and University College Libraries at Oxford; (2.) On the fundamental notions of mathematics, *De Communibus Mathematicis*, part of which is in the Sloane collection, part in the Bodleian; (3.) *Baconis Physica*, contained among the additional MSS. in the British Museum; (4.) The fragment called *Quinta Pars Compendii Theologiæ*,

Nature, 1542—English translation, 1659; (3.) *Libellus de Retardandis Senectutis Accidentibus*, 1590—translated as the "Cure of Old Age," 1683; (4.) *Sanioris Medicinæ Magistri D. Rogeri Baconis Anglici de Arte Chymicæ Scripta*, 1603—a collection of small tracts containing *Excerpta de Libro Avicennæ de Anima*, *Breve Breviarium*, *Verbum Abbreviatum*,² *Secretum Secretorum*, *Tractatus Trium Verborum*, and *Speculum Secretorum*; (5.) *Perspectiva*, 1614, which is the fifth part of the *Opus Majus*; (6.) *Specula Mathematica*, which is the fourth part of the same; (7.) *Opus Majus ad Clementem IV.*, edited by Jebb, 1733; (8.) *Opera hactenus Inedita*, by J. S. Brewer, 1859, containing the *Opus Tertium*, *Opus Minus*, *Compendium Studii Philosophiæ*, and the *De Secretis Operibus Naturæ*.

How these works stand related to one another can only be determined by internal evidence, and this is a somewhat hazardous method. The smaller works, which are chiefly on alchemy, are unimportant, and the dates of their composition cannot be ascertained. It is known that before the *Opus Majus* Bacon had already written some tracts, among which an unpublished work, *Computus Naturalium*, on chronology, belongs probably to the year 1263; while, if the dedication of the *De Secretis Operibus* be authentic, that short treatise must have been composed before 1249.

It is, however, with the *Opus Majus* that Bacon's real activity begins. That great work, which has been called by Whewell at once the Encyclopædia and the Organum of the 13th century, requires a much fuller notice than can here be given. As published by Jebb it consists of six parts; there should, however, be a seventh, *De Morali Philosophiâ*, frequently referred to in the *Opus Tertium*. Part I. (pp. 1–22), which is sometimes designated *De Utilitate Scientiarum*, treats of the four *offendicula*, or causes of error. These are, authority, custom, the opinion of the unskilled many, and the concealment of real ignorance with show or pretence of knowledge. The last error is the most dangerous, and is, in a sense, the cause of all the others. The *offendicula* have sometimes been looked upon as an anticipation of the more celebrated doctrine of *Idola*; the two classifications, however, have little in common. In the summary of this part, contained in the *Opus Tertium*, Bacon shows very clearly his perception of the unity of science, and the necessity of an encyclopædic treatment. "Nam omnes scientiæ sunt annexæ, et mutuis se fovant auxiliis, sicut partes ejusdem totius, quarum qualibet opus suum peragit, non solum propter se, sed pro aliis."—(*Op. Ined.*, p. 18.)

Part II. (pp. 23–43) treats of the relation between philosophy and theology. All true wisdom is contained in the Scriptures, at least implicitly; and the true end of philosophy is to rise from the imperfect knowledge of created things to a knowledge of the Creator. Ancient philosophers, who had not the Scriptures, received direct illumination from God, and only thus can the brilliant results attained by them be accounted for.

Part III. (pp. 44–57) treats of the utility of grammar, and the necessity of a true linguistic science for the adequate comprehension either of the Scriptures or of books on philosophy. The necessity of accurate acquaintance with any foreign language, and of obtaining good texts, is a subject Bacon is never weary of decanting upon. He lays down very clearly the requisites of a good translator; he should know thoroughly the language he is translating

in the Brit. Mus.; (5.) the *Metaphysica*, in the Biblioth. Impér. at Paris; (6.) The *Compendium Studii Theologiæ*, in the Brit. Mus.; (7.) The logical fragments, such as the *Summa Dialecticæ*, in the Bodleian, and the glosses upon Aristotle's physics and metaphysics in the library at Amiens.

² At the close of the *Verb. Abbrev.* is a curious note, concluding with the words, "*ipse Rogerus fuit discipulus fratris Alberti!*"

from, the language into which he is translating, and the subject of which the book treats.

Part IV. (57–255) contains an elaborate treatise on mathematics, "the alphabet of philosophy," and on its importance in science and theology. Bacon shows at great length that all the sciences rest ultimately on mathematics, and progress only when their facts can be subsumed under mathematical principles. This singularly fruitful thought he exemplifies and illustrates by showing how geometry is applied to the action of natural bodies, and demonstrating by geometrical figures certain laws of physical forces. He also shows how his method may be used to determine some curious and long-discussed problems, such as the light of the stars, the ebb and flow of the tide, the motion of the balance. He then proceeds to adduce elaborate and sometimes slightly grotesque reasons tending to prove that mathematical knowledge is essential in theology, and closes this section of his work with two comprehensive sketches of geography and astronomy. That on geography is particularly good, and is interesting as having been read by Columbus, who lighted on it in Petrus de Alliaco's *Imago Mundi*, and was strongly influenced by its reasoning.

Part V. (pp. 256–357) treats of perspective. This was the part of his work on which Bacon most prided himself, and in it, we may add, he seems to owe most to the Arab writers Alkindi and Alhazen. The treatise opens with an able sketch of psychology, founded upon, but in some important respects varying from, Aristotle's *De Anima*. The anatomy of the eye is next described; this is done well and evidently at first hand, though the functions of the parts are not given with complete accuracy. Many other points of physiological optics are touched on, in general erroneously. Bacon then discusses very fully vision in a right line, the laws of reflection and refraction, and the construction of mirrors and lenses. In this part of the work, as in the preceding, his reasoning depends essentially upon his peculiar view of natural agents and their activities. His fundamental physical maxims are matter and force; the latter he calls *virtus*, *species*, *imago agentis*, and by numberless other names. Change, or any natural phenomenon, is produced by the impression of a *virtus* or *species* on matter—the result being the thing known. Physical action is, therefore, *impression*, or transmission of force in lines, and must accordingly be explained geometrically. This view of nature Bacon considered fundamental, and it lies, indeed, at the root of his whole philosophy. To the short notices of it given in the 4th and 5th parts of the *Opus Majus*, he subjoined two, or perhaps three, extended accounts of it. We possess at least one of these in the tract *De Multiplicatione Specierum*, printed as part of the *Opus Majus* by Jebb (pp. 358–444). We cannot do more than refer to Charles for discussions as to how this theory of nature is connected with the metaphysical problems of force and matter, with the logical doctrine of universals, and in general with Bacon's theory of knowledge.

Part VI. (pp. 445–477) treats of experimental science, "*domina omnium scientiarum.*" There are two methods of knowledge: the one by argument, the other by experience. Mere argument is never sufficient; it may decide a question, but gives no satisfaction or certainty to the mind, which can only be convinced by immediate inspection or intuition. Now this is what experience gives. But experience is of two sorts, external and internal; the first is that usually called experiment, but it can give no complete knowledge even of corporeal things, much less of spiritual. On the other hand, in inner experience the mind is illuminated by the divine truth, and of this supernatural enlightenment there are seven grades.

Experimental science, which in the *Opus Tertium* (p. 46) is distinguished from the speculative sciences and the

operative arts in a way that forcibly reminds us of Francis Bacon, is said to have three great *prerogatives* over all other sciences:—(1.) It verifies their conclusions by direct experiment; (2.) It discovers truths which they could never reach; (3.) It investigates the secrets of nature, and opens to us a knowledge of past and future. As an instance of his method, Bacon gives an investigation into the nature and cause of the rainbow, which is really a very fine specimen of inductive research.

The seventh part of the *Opus Majus*, not given in Jebb's edition, is noticed at considerable length in the *Opus Tertium* (cap. xiv.) Extracts from it are given by Charles, (pp. 339–348).

As has been seen, Bacon had no sooner finished this elaborate work than he began to prepare a summary to be sent along with it. Of this summary, or *Opus Minus*, part has come down and is published in Brewer's *Op. Ined.* (313–389), from what appears to be the only MS. The work was intended to contain an abstract of the *Opus Majus*, an account of the principal vices of theology, and treatises on speculative and practical alchemy. At the same time, or immediately after, Bacon began a third work as a preamble to the other two, giving their general scope and aim, but supplementing them in many points. The part of this work, generally called *Opus Tertium*, is printed by Brewer (pp. 1–310), who considers it to be a complete treatise. Charles, however, has given good grounds for supposing that it is merely a preface, and that the work went on to discuss grammar, logic (which Bacon thought of little service, as reasoning was innate), mathematics, general physics, metaphysics, and moral philosophy. He founds his argument mainly on passages in the *Communio Naturalium*, which indeed prove distinctly that it was sent to Clement, and cannot, therefore, form part of the *Compendium*, as Brewer seems to think. It must be confessed, however, that nothing can well be more confusing than the references in Bacon's works, and it seems well-nigh hopeless to attempt a complete arrangement of them until the texts have been collated and carefully printed.

All these large works Bacon appears to have looked on as preliminaries, introductions, leading to a great work which should embrace the principles of all the sciences. This great work, which is perhaps the frequently referred to *Liber Sex Scientiarum*, he began, and a few fragments still indicate its outline. First appears to have come the treatise now called *Compendium Studii Philosophiæ* (Brewer, pp. 393–519), containing an account of the causes of error, and then entering at length upon grammar. After that, apparently, logic was to be treated; then, possibly, mathematics and physics; then speculative alchemy and experimental science. It is, however, very difficult, in the present state of our knowledge of the MSS., to hazard even conjectures as to the contents and nature of this last and most comprehensive work.

Bacon's fame in popular estimation has always rested on his mechanical discoveries. Careful research has shown that very little in this department can with accuracy be ascribed to him. He certainly describes a method of constructing a telescope, but not so as to lead one to conclude that he was in possession of that instrument. Gunpowder, the invention of which has been claimed for him on the ground of a passage in his works, which fairly interpreted at once disposes of any such claim, was already known to the Arabs. Burning-glasses were in common use, and spectacles it does not appear he made, although he was probably acquainted with the principle of their construction. His wonderful predictions (in the *De Secretis*) must be taken *cum grano salis*; and it is not to be forgotten that he believed in astrology, in the doctrine of signatures, and in the philosopher's stone, and knew that the circle had been squared.

The best work on Roger Bacon is undoubtedly that of E. Charles, *Roger Bacon, sa Vie, ses Ouvrages, ses Doctrines d'après des textes inédits*, 1861. Against the somewhat enthusiastic estimate and modern interpretation given in this work, Schneider in his *Roger Bacon, Eine Monographie*, Augsburg, 1873, has reclaimed. He points out very clearly certain aspects in which Bacon appears as a mere scholastic. The new matter contained in the publications of Charles and Brewer was summarised by H. Siebert, *Roger Bacon: Inaugural Dissertation*, Marburg, 1861. Cf. also, J. K. Ingram, *On the Opus Majus of Bacon*, Dublin, 1858; Cousin, *Fragments, Phil. du Moyen Age* (reprinted from *Journal des Savans*, 1848); Saisset, *Précurseurs et Disciples de Descartes*, pp. 1-58 (reprinted from *Revue de Deux Mondes*, 1861); Prantl, *Gesch. der Logik*, iii. 120-129 (a severe criticism of Bacon's logical doctrines). (R. AD.)

BACONTHORPE, or BACON, JOHN, called The Resolute Doctor, a learned monk, born towards the end of the 13th century, at Baconthorpe, a village in Norfolk. After spending the early part of his life in the convent of Blakeney, near Walsingham, he removed to Oxford, and from that city to Paris, where he obtained great reputation for his learning, and was esteemed the principal of the Averroists. In 1329 he returned to England, and was chosen twelfth provincial of the English Carmelites. In 1333 he was sent for to Rome, where, we are told, he first maintained the Pope's sovereign authority in cases of divorce; but this opinion he is understood to have afterwards retracted. He died in London in 1346. His chief work was published in 1510, with the title *Doctoris resoluti Joannis Baconis Anglici Carmelite radiantissimi opus super quatuor sententiarum fibris*, 4 vols. folio; it has passed through several editions. The little that is known of this schoolman, who in his own day and order had a reputation rivalling that of Thomas Aquinas, may be seen in Brucker, *Hist. Crit.*, iii. 865; Stöckl, *Phil. d. Mittel.* ii. 1044-5; Hauréau, *Phil. Scol.*, ii. 476; Prantl, *Ges. d. Logik*, iii. 318.

BACSANYI, JANOS, a Hungarian poet, was born at Tapozeza, May 11, 1763, and died at Linz, May 12, 1845. In 1785 he published his first work, a patriotic poem, *The Valour of the Magyars*. In the same year he obtained a situation as clerk in the treasury at Kaschau, and there, in conjunction with other two Hungarian patriots, edited the *Magyar Museum*, which was suppressed by the Government in 1792. In the following year he was deprived of his clerkship; and in 1794, having taken part in the conspiracy of Bishop Martinovich, he was thrown into the state prison of the Spielberg, near Brünn, where he remained for two years. After his release he took a considerable share in the *Magyar Minerva*, a literary review, and then proceeded to Vienna, where he obtained a post in the bank, and married. In 1809 he translated Napoleon's proclamation to the Magyars, and, in consequence of this anti-Austrian act, had to take refuge in Paris. After the fall of Napoleon he was given up to the Austrians, who allowed him to reside at Linz, on condition of never leaving that town. He published a collection of poems at Pesth, 1827 (second edition, Buda, 1835), and also edited the poetical works of Anyos and Faludi.

BACTRIA, or BACTRIANA, an ancient country of Central Asia, lying to the south of the River Oxus, and reaching to the western part of the Paropamisian range, or Hindu Kush. It was sometimes regarded as including the district of Margiana, or Merv, which was more frequently considered as distinct. The character of the country is very various, and has been well described by Curtius, whose account is confirmed by the few modern travellers who have passed through it. Some portions are remarkable for the beauty of their scenery, or the fertility of the soil, evidenced by a rich and varied vegetation, while other parts are stretches of barren and drifting sands. In early history Bactria is connected with some of the most important movements of the Indo-European races, and has no small claims to be regarded as the cradle of our present civilisation. Accord-

ing to Persian tradition, it became the seat of the Iranian wanderers, who established the religion of Zoroaster, and expelled the Vedic inhabitants of the country. In the 7th century B.C. it passed under the dominion of the Medes, and not long after formed part of the conquests of Cyrus. In the reign of Darius it ranked as the twelfth satrapy of the empire, and furnished valuable contingents to the imperial army; these are described at a later date by Herodotus as wearing the Median head-dress, and making use of their native bows and short spears. Like the rest of Western Asia, Bactria was subjugated by Alexander, and formed part of the empire of the Seleucids; but in the 3d century B.C. it was raised to the rank of an independent kingdom by the successful revolt of Diodotus, the Greek satrap. There thus arose a remarkable dynasty—if dynasty it can be called—of Græco-Bactrian kings, who have been the object of much modern investigation, but are not as yet arranged in any satisfactory order. The names of seven or eight of them are known from the Greek and Roman historians, and upwards of forty are preserved on their coins. The great problem to be solved by numismatists is how to dispose of so many claimants in the comparatively narrow space of time at their disposal. It is highly probable that many of them held contemporaneous sway in different parts of the Bactrian region, sometimes with a distinct preponderance on the part of one, and sometimes with practical equilibrium of power; but their geographical distribution can only be conjectured from what are understood to be mint-marks on their coins. The period of the final disintegration of the Græco-Bactrian power is not definitely ascertained; but as early as the time of Eucratides (160 B.C.) there appears on the coinage the so-called Bactrian Pali, a language cognate with Sanskrit but written in characters of seemingly Phœnician origin. Besides these monetary legends, several Bactrian inscriptions have been recently discovered, among the most important of which are the "Taxila" copperplate, which has furnished the key to the Bactrian numeral system, the Peshawur vase, the Manikyala cylinder, the Bimaran vase, and the Wardak urn, but none of them are of very much historical value. Bactria seems to have passed successively under the power of various Saca and Parthian and so-called Indo-Scythian rulers, and during the first six or seven centuries of the Christian era it became one of the most important centres of Buddhist monasticism. (See BALKH.) Its modern history is of but little importance, as it has never formed an independent kingdom of any power or stability.

See Bayer, *Hist. Reg. Græco-Bactr.*, Petrop., 1738; Köhler, *Méd. grecques des Rois de la B.*, St. Pet., 1822-3; Tychsen, *Comm. Recen. Götting.*, v. vi.; Tod, in *Roy. Asiatic Soc. Trans.*, 1824; Schlegel, in *Journ. Asiat.*, 1828; Prinsep, in *J. of Asiatic Soc. Bengal*, 1833-38; Raoul-Rochette, in *Jour. des Savants*, 1834-39 and 1844; Jacquet, in *J. Asiat.*, 1836; Masson, in *J. of Asiatic Soc. Bengal*, 1836; K. O. Müller, in *Göttingen Anzeigen*, 1835 and 1838; Mionnet, in *Supplément viii. to his Description, &c.*, 1837; Lassen, *Zur Gesch. der Griech. u. Indoskyth. Kön.*, Bonn, 1833; Grotefend, *Die Münzen der Kön. v. Bactr.*, Hanover, 1839; Wilson, *Ariana Antiqua*, 1841; Cunningham, *Numism. Chron.*, viii. 1843; Lassen, *Indische Alterthumskunde*, vol. ii., 1852; Babu Rajendra Lal, in *J. Asiat. Soc. of Bengal*, 1861; E. Thomas, "Bactrian Coins," in *J. Roy. Asiatic Soc. Gr. Brit. and I.*, 1873; Dowson, "B. Pali Inscr.," *ibidem*.

BACUP, a town of England, in Lancashire, 20 miles N. from Manchester. It is situated in a beautiful valley on the River Speddon, and is a station on the East Lancashire railway. It is chiefly important for its factories, foundries, and mills, as well as for the coal-mines in the neighbourhood. Since 1841, when the population of the chapelry was only 1526, Bacup has rapidly increased, and its sanitary condition has been greatly improved by the exertions of a local board. The river has been deepened for a mile above the town, and a water supply has been secured by means of a reservoir at Higher Stacks. There are two Episcopal

churches and several dissenting places of worship, a mechanics' institute and library, and various other institutions. A new market-hall was built in 1867. Population of local board district in 1871, 17,199.

BADAJOS, a province of Spain, forming, by the division of 1833, the southern half of the old province of Estremadura, or what is generally called Lower Estremadura. It is bounded on the N. by Caceres, E. by Ciudad Real, S. and S.E. by Cordova, Seville, and Huelva, and W. by Portugal, embracing an area of 8687 square miles. See ESTREMADURA.

BADAJOS, the capital of the above province, is a fortified city, and the see of a bishop. It is situated about 5 miles from the Portuguese frontier, on a slight elevation near the left bank of the Guadiana, and is one of the principal stations on the railway between Madrid and Lisbon. The height is crowned by the ruins of a Moorish castle. A strong wall and bastions, with a broad moat and outworks, and forts on the surrounding heights, make the city a place of great strength. The river is crossed by a magnificent granite bridge, originally built in 1460, repaired in 1597, and rebuilt in 1833. The city is well built, and contains an arsenal, a cathedral, built like a fortress and bombproof, several churches, hospitals, and schools. Its monasteries are all secularised, one being occupied as infantry barracks; and some of its nunneries are closed. Badajos was finally taken from the Moors in 1235 by Alphonso IX., and from its importance as a frontier garrison has since been the scene of numerous sieges. The last and most severe was in 1812, when it was stormed by the British troops under Wellington and carried with dreadful loss. The town was delivered up to a two days' pillage. It had been surrendered the previous year to Soult by the treachery of Imaz, the commander of the garrison. The trade and manufactures of Badajos are considerable, and much contraband traffic is carried on with Portugal. Badajos is the birthplace of the painter Luis de Morales and of Manuel Godoy. Pop. 22,895.

BADAKHSHAN, a country of Central Asia, situated in the upper valley of the Kokcha river, one of the principal head streams of the Oxus. The name has been variously spelt Badascian, Balacian, Balakhshan, Balashan, Balaxien and Balaxia. Including Wakhan, it lies between 35° 50' and 38° N. lat., and between 69° 30' and 74° 20' E. long. The chief ascertained positions are as follows: Faizábád, 37° 2' N., 70° 36' E.; Ishkashm, 36° 45' N., 71° 38' E.; Punja, 37° 5' N., 72° 39' E.; and Karkat Yassin lake, 37° 14' N., 74° 18' E. Its extent from east to west is about 200 miles, and from north to south about 150 miles. On the north it is bounded by Kulab and Darwaz; on the east by the lofty table-land of Pamir; on the south by the Hindu Kush range; and on the west by Kunduz. The Pamir land is the principal watershed of Asia, and Badakhshan forms part of the western water slope constituting the basin of the Oxus. The country is for the most part mountainous, but there are numerous plains and fertile valleys. The general slope of the country is great, since Kunduz is probably not more than 500 feet above the level of the sea, while Lake Victoria, close to the principal watershed, is estimated at 15,600 feet.

Badakhshan comprises 16 districts. The principal district called Faizábád is under the rule of the Mir Mahmúd Shah; the others are dependencies ruled by relatives of the Mir, or by hereditary feudatories. Each ruler is independent, but is bound to aid the Mir of Faizábád in time of need. The Mir himself pays tribute to the Amir of Cabul. The other districts besides Faizábád are Daraim, Shahr-i-buzurg, Gumbuz, Farakhar, Kishm, Rustak, Rushán, Shighnán, Ishkashm, Wakhán, Zebak, Minján, Ragh, Daung, and Asiábá. Each district has its sub-divisions. In Faizábád there are several fertile tracts; amongst them are the hilly regions of Yaftal and Shewá, which are thickly popu-

lated, the former by Tajiks, and the latter by Turks of the Jakha Moghal tribe; and the plateaus of Argú and Shewá, of which the former is somewhat higher than the plain of Faizábád, about 15 miles in length by about 8 in breadth, and well cultivated, while the latter is still higher, and forms the best and largest pasture ground in Badakhshan. A lake named Sir-i-kol, about 20 miles in circumference, is situated on the Shewá plateau. In and around Faizábád there are numerous excellent fruit and flower gardens; the principal manufactures are cast-iron pots, boots and shoes, and a material woven from silk and cotton, called *ilacha*. The district of Jirm, also subject to Mahmúd Shah, comprises numerous rich valleys, as well as the famous mineral region called Yamgan, or "all mines." The mines yield rubies, lapis lazuli, lead, alum, sal-ammoniac, sulphur, copper, &c. The annual yield of lapis lazuli averages about £1500, which is sold at the rate of seven shillings per pound; it is exported to Russia, Kashmir, and China. The Dasht-Baha-rak is an extensive plain in this district, on which was formerly situated a large city, once the capital of Badakhshan. There are several villages on it, as also the summer residence of the Mir. The caravan route from India to Faizábád passes over this plain. The districts of Rustak, Ragh, Kishm, Daraim, and Shahr-i-buzurg are next in importance as regards fertility and population. They abound in fertile hills and plains. The principal cultivated products are wheat, rice, *Cicer arietinum*, *Phaseolus Mungo*, cotton, linseed, poppy, sesame, apples, grapes, mulberries (which form the principal article of food in these regions), pears, apricots, walnuts, melons, gourds, turnips, radishes, carrots, spinach, leeks, as also numerous garden flowers and timber trees. The districts of Minjan and Rushan are more mountainous, have a cooler climate, and are more sparsely populated than the foregoing. Their inhabitants are also distinct, differing in physical features, creed, language, and habits. The celebrated ruby mines are in Ishkashm; they have not been worked for more than 30 years, except temporarily in 1866. It is, however, suspected that they are worked surreptitiously by the people. They yield the well-known Balas (*i.e.*, Badakhshan) ruby.

The principal domesticated animal is the yak. There are also large flocks of sheep, cows, goats, ponies, numerous fine dogs, and Bactrian camels. The more important wild animals are a large wild sheep (*Ovis poli*), foxes, wolves, jackals, bears, boars, deer, and lions; amongst birds, there are partridges, pheasants, ravens, jays, sparrows, larks, a famous breed of hawks, &c.

Badakhshan proper is peopled by Tajiks, Turks, and Arabs, who speak the Persian and Turki languages, and profess the orthodox doctrines of the Mahometan law adopted by the Sunnite sect; while the mountainous districts are inhabited by Tajiks, professing the Shia creed, and speaking distinct dialects in different districts.

Badakhshan was visited by Hwen Thsang in 630 and 644. The Arabian geographers of the 10th century speak of its mines of ruby and azure, and give notices of the flourishing commerce and large towns of Waksh and Khotl, regions which appear either to have in part corresponded with or to have lain close to Badakhshan. In 1272-73 Marco Polo and his companions stayed for a time in Badakhshan. During this and the following centuries the country was governed by kings who claimed to be descendants of Alexander the Great. The last of these kings was Shah Mahomet, who died in the middle of the 15th century, leaving only his married daughters to represent the royal line. Early in the middle of the 16th century the Uzbeks obtained possession of Badakhshan, but were soon expelled, and then the country was generally governed by descendants of the old royal dynasty by the female line. About the middle of the 18th century the present dynasty of