LVI. On the fate and character of the monk Roger Bacon Read before the Literary and Philosophical Society

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result; so that it seemed deducible from it, that $\frac{1}{30}$ th part of carbon in addition to any quantity of iron was insufficient to form steel; and, referring to the result of No. VI., it appeared that even $\frac{1}{20}$ th part formed a steel much too soft for the general purposes of manufacture. This conclusion, however, being at variance with facts I had already established upon the formation of cast steel in common crucibles, was here inadmissible. It was therefore necessary to seek for an explanation of the phenomenon of the charcoal disappearing in close vessels, formerly alluded to, before any certain knowledge of the exact quantities of charcoal could be ascertained, which were necessary to form either cast iron or steel in vessels made impervious to the air*. I uniformly remarked in the present experiments, that when the quantity of charcoal introduced was from $\frac{1}{30}$ th to $\frac{1}{20}$ th the weight of the iron, a portion of glass was constantly formed upon the surface of the metallic button. The quantity generally increased as the proportion of charcoal decreased; so that, in some experiments, 300, 350, and 400 grains of amber-colour glass was obtained. The upper surface of this glass was frequently of a pure pearly white colour. In one experiment, where $\frac{1}{70}$ th of charcoal was used, I obtained a large quantity of glass cellular throughout. Each cell was surmounted upon the top with concentric circles of pearly lines, forming a curious and pleasing effect.

Having fully satisfied myself that operations performed in close vessels thus prepared were subject to uncertainty, arising as well from the formation of glass as from some unknown affinity exerted upon the charcoal; and having performed several experiments with well filled open crucibles, with charcoal alone, wherein I found little comparative loss, I performed a very accurate series of experiments, which shall be forwarded for the next number of the Magazine.

LVI. *On the Fate and Character of the Monk ROGER BACON.* By Governor POWNALL. Read before the Literary and Philosophical Society, Bath†.

THERE has been much bustle about learning in the world: every age has had its learning; the produce and growth of a desultory activity of the imagination, according to the fashion of thinking prevalent at the time: whilst the

* This investigation will form a separate paper for July.

† Communicated by the Author.

slow silent progress of the reasoning power is hardly ever noticed in its operations, and seldom received in its effects when they come forward, because not understood at the time.

It would be a curious detail were we to enumerate the various fancies and follies which have been called learning, which have been studied and applauded as such in every age and every country; but it is at the same time a humiliating truth, that knowledge, which it should seem is congenial to the right operation of the human intellect in the investigation of truth, has come forward to men but slowly and sparingly, and at epochs of very distant periods, and at the intervals of very distant centuries: and what is more humiliating in the history of man is, that, when at any time it appears, it comes into the world as an *enfant trouvé*, and is received as such, rather than nurtured by those whose relation to it should be in practice, as it is in nature, congenial to it. True knowledge is therefore generally either despised by the conceit of the learning in fashion, or more generally suspected as dangerous; which, indeed, it always is to the false and artificial authority which assumes and takes the lead in the world.

It is with pain that I have to notice several eminent examples of this melancholy truth in the course of my stating the character and fate of the monk Roger Bacon, who is the subject of this paper.

When Socrates came forward to the world, the powers of the human mind, absorbed in the false learning of Greece, had been employed to propagate the sophistry and support the sophists of the time, whose system and business were to keep mankind from true knowledge by an avowed principle of such ignorance as was incapable of attaining truth; the purport of which system was to hold men in a servile obedience to authority, as those who had the command of that authority should impose it. Socrates in his theology taught only those truths which had been known to the ancient philosophers of Greece, and which they had brought from the east. What they affected to conceal he taught openly, so far as went to establish the knowledge of a *moral system* connecting the divine and human nature. *Here he was original*: this was a new truth brought forward to the world. In this, as it is truly said of him, he brought down truth from heaven, and established it on a moral foundation on earth.

As to his manner of teaching, he with great address, in accommodation to the learning of the time, professed to commence in ignorance. But whilst the sophists led, in synthetic reasoning, from ignorance to a total incapacity in man for truth; he, commencing his theorem from stated ignorance,

ignorance, proceeded by *analytic induction* to the eliciting of truth: as the algebraists have since done, from a theorem stated on an unknown quantity, bringing out the true one. He thus not only brought truth to light by reason, but by the very mode of his reasoning taught the use, the extent, and the right of human reason. This was sufficient to decide the fate which both the teacher and his doctrines experienced. His doctrines were despised, and attempts were made by the wits of the time to ridicule his knowledge: it was represented as evolved from the clouds*. But, as truth will stand the test of ridicule, nothing remained but *to decide by authority* that the truths which he taught were inadmissible; and they were therefore *interdicted by power*: and Socrates himself was prosecuted and condemned to death as a false teacher, as a corrupter of men, an heretic, unbeliever, and despiser of the gods! What is still more humiliating to the character of man, the doctrines which he taught, and the truths which he published, were perverted where received, and even by his disciples. The homely simplicity of his doctrines was sophistified and corrupted, in a line of learning, to uses per-verse of their nature.

I will not here glance, although it is in my mind's eye, at the similar fate of a Divine teacher who came forward in the world to enlighten man, and to instruct him in his most essential duty and interest.

Pursuing therefore the fate of Socrates, which is not irrelevant to the matter of this paper, I shall proceed to state that Plato, his favourite disciple, who was a really great mathematician, and particularly conversant in the *analytic process* of that science, and who followed the steps of induction marked out by Socrates, mixed so many mystic conceits and theories, that he sublimed and subtilized truth to a mere learned vision, such as the latter Platonists afterward taught.

Aristotle, on the other hand, a distinguished disciple of Plato, converted the knowledge of physics, both material and intellectual, into *an artificial system* of axioms, data, and maxims, and formed thereon a *logical frame* of synthesis; which gave occasion to his immediate followers and to the Peripatetic school to found their learning on the authority of teaching, instead of being founded on *truth* led by experience to knowledge, to the disgrace of human intellect, and the perversion of true philosophy.

It is lamentable to reflect how many theories and mysteries, divine as well as natural, sprang from this foul ground;

* Vide the Nubes Aristophanis.

which,

which, like meteors, blazed in the regions of learning for a time, but, like such meteors, not deriving from true and permanent light, from proper sources, were soon extinguished.

Truth, however, was pursued with great energy, *occulto velut arbor in ævo*, in the studies and labours of those few votaries of it who were called mathematicians; and many detached unconnected discoveries were made, which hardly ventured to show themselves, or, where they did, were imputed to magic.

At length, after many ages of darkness, Roger Bacon, that great luminary, was born in 1214. He, like another Socrates, in the spirit of truth, in the analytic line of true knowledge, endeavoured to state the *Impedimenta scientiæ*, the *Causas ignorantiae*, and to remove all the obstructions which shut up the road to truth: he then, explaining by fact and example the *Utilitas scientiarum*, advanced, by an experimental investigation of nature, and by an analysis of truth, to his *Restauratio humani intellectus*, and his *Instauratio scientiæ*.

Reasoning, however, above the scale of the learning of the age in which he lived, his doctrines were neither understood nor received; and, where they could not be repressed by the learning of the time, *they were interdicted by the ruling authority* of it. Although the truths which he discovered, and endeavoured to disclose to the world, were listened to by several men of knowledge, and some of them in power*, and though they were received even by the *supreme*† authority, held infallible; yet, by a *sin against the holy spirit of truth*, they were unacknowledged, and suffered to languish in obscurity. They, with the teacher, were delivered over to persecution; truth was extinguished, and the discoverer and teacher imprisoned for the crimes of magic and heresy.

Here again, on the stage of this world, was truth devoted to silence and darkness, and the discoverer and teacher of it thrown back into obscurity, and his doctrines lost in oblivion, except what ignorance rakes up to memory in disgraceful tales of tradition. The stream, therefore, of this original spring, whence the knowledge of latter times derives its source, ran, like the Rhone, concealed and unknown for three or four centuries; whilst in the mean time various empirics in philosophy, various baseless theories, (amidst which the ingenious fables of Descartes more especially,) took the lead and ascendancy in the learning of the world. This stream, however, like the Rhone, emerged again to light on the face

* Bishop Grossthead.

† By the Pope.

of the earth, when its course became directed with happier success, and under more fortunate auspices, by the energy and spirit of *another Bacon*, the great lord St. Albans, who, although perhaps an original also, was a second and more fortunate one; yet even not generally known and acknowledged as such till near half a century was elapsed from the time in which he wrote.

Although Sir Isaac Newton had made the chief part of his discoveries on light and colours, and had written the first parts of his Treatise on Optics, and, "at the desire of several gentlemen of the Royal Society, sent them to the secretary of that society, where they were read in 1675; and although the other parts were added about 12 years after; yet to avoid, as he says, being engaged in disputes about these matters, he delayed the printing and publishing of them to 1704; and would still have delayed, had not the importunity of some friends overcome the repression which he experienced from the jealousy of some authoritative leaders." Such is the invariable spirit and temper of man even in an enlightened age, and such is the unavoidable fate of those who would enlighten and assist the knowledge of the world. Such, at least, were the feelings of this great and humble spirit; such was his conviction, that the age in which he first made his discoveries was neither willing to receive nor capable of possessing them, to the purpose of truth, that the world might have been deprived of them for ever, as in fact it is at this moment of some discoveries which he had in view and in pursuit, but which he ceased to follow up, and has suggested only in queries. What a loss to mankind that these suggestions, except in some particular instances, have not been pursued! For, whatever and howsoever great the discoveries which have been brought forward by the new philosophic chemists may be; yet these important suggestions would, as they have done in some instances where they have been taken up, have led to great and interesting philosophic facts hardly at present conceivable.

It was from the same opinion of the temper and want of qualification in that age, perhaps also from an oppression of spirit which he felt, that on another occasion, when consulted by Dr. Bentley, at the time of his being appointed to preach the Boyle's lectures, Sir Isaac says in his letter, "There is yet another argument in proof of the Deity, which I take to be a very strong one; but until the principles on which it is grounded are better received, I think it more advisable to let it sleep." Such has ever been the fate of knowledge, both to the discoverers and to truth itself, on its first appearance,

appearances amongst those who hold the lead of learning. Shall we then wonder at the fate which this true and real philosopher, the monk Roger Bacon, experienced in an ignorant, superstitious, and servilely debased age?

To point out the real merit and character of this wonderful man, which is the purport of this paper, I shall now proceed to a review and general analysis of his doctrines as stated in his *Opus Majus*.

I trust it will be found to be an amazing extensive plan, founded in experience of nature and on the analysis of truth; conducted by the most penetrating inventive faculties of induction, and the most exact precision of combination; that it is, as I said before, a *Restauratio humani intellectus*, and an *Instauratio scientiæ*.

I. It first states the causes of error, and then clears the ground of them; discards all pretensions to knowledge which obtrude themselves under the form of learning.

Sufficit nobis in inquisitione proprii intellectus ut, quantum possumus, causas et occasiones erroris extraneas longius à debilitate sensus nostri religamus. Quatuor vero sunt maxima comprehendendæ veritatis offencicula, quæ omnem quemcunque sapientem impediunt; et vix aliquem permittunt advorsum titulum sapientiæ pervenire.

1mo. Fragilis et indignæ autoritatis exemplum.

Mark here the ground on which, in those days of ecclesiastical and civil tyranny, the crime of heresy against the church, and of treason against the state, might be imputed, and which was the real ground of his persecution and imprisonment.

2do. Consuetudinis diuturnitas.

3tio. Vulgi sensus imperiti.

4to. Propriæ ignorantiae occultatio cum ostentatione sapientiæ.

His omnis homo involvitur, omnis status occupatur.

II. These four points he examines, explains, and discusses specially and at full length under their several heads. The ground thus cleared, and the foundations thus laid, he proceeds in the *second part* in analysing grammar to its elements; wherein he not only goes to the art of language, but to the powers and operations of the mind, by an inquisition into the human understanding, as Mr. Locke, and Mr. Harris in his *Hermes* did afterward.

Then, passing by the commonly received mode of reasoning, as it moves in the trammels of logic, which this great original states to be not only perverse, but at best a mere left-handed hold by which we take truths already discovered;

by

by which we lock them up in an artificial system, and which is of no use or aid in the pursuit and the discovery and invention of truth; he then treats of the virtue, power, and use of mathematics, properly so called, both analytic in the investigation of truth, and synthetic in conducting it to practical science.

4. By this conductor he goes first through the investigation, and next through the didactic explanation and proof of the powers and operations of nature, by the principles of the laws of motion, attraction, gravity. Guided by these principles he proceeds to the laws of vision, perspective, and optics in general; and to the laws by which light is acted upon. And here he goes to the mechanical and instrumental, so as to explain the practical part, bringing forward many improved uses and applications leading to new discoveries.

5. He proceeds hence to astronomy, in an investigation of the phenomena of the heavenly bodies. In this part some remains of astrological prejudices not yet eradicated obstruct his institute.

6. The heads above stated take up five parts out of six into which his *Opus Majus* is divided. He then, in the *sixth part*, comes to the main ground and true basis on which the *Instauratio scientiæ* is founded and built up, which is *experimental induction*. This he explains in detail, and illustrates by example; recurring again and again to the phenomena of nature terrestrial and celestial:—* *Duo sunt modi cognoscendi, scilicet, per argumentum et experimentum. Argumentum concludit, et facit concludere quæstionem; sed non certificat, neque removet dubitationem, ut quiescat animus in intuitu veritatis, nisi eam inveniat viâ experientiae.*

Et quia hæc scientia experimentalis à vulgo studentium est penitus ignorata, ideo non possum persuadere de ejus utilitate, nisi simul ejus virtus et proprietas ostenduntur.

Whoever, divested of preoccupation and prejudice as they spring from the *Consuetudinis* † *diuturnitas*, and the fascination of received fashion in thinking, reads this great work, with comparative reference to the *Instauratio scientiarum* of the second Bacon, the lord St. Albans, will find both works similarly grounded, and similarly conducted, as to the method and form; both alike built up on an institute of induction by *experimental science*; both in the execution pursuing the same line to the same point; and must conclude either, according to the old proverb, "*that great wits jump*;" or that the latter Bacon, although perhaps equally an original as the

* Cap. 1 and 2. partis 6tæ, de Scientiâ experimentalî.

† Explained in the second head of part 1.

first, had read and received a reflected ray of illumination from the works of the first Bacon, our philosopher.

These works of the monk had been buried, amidst the manuscripts of such learning as is never read, for three or four hundred years before the time in which the lord St. Albans wrote; and continued in the same state for near a century after, to 1733, when they were published by the learned editor Dr. Jebb; yet they might not have escaped the scrutinizing, industrious, inquisitive genius and informed studies of the second great philosopher. But let me here repeat, that whatever cause or chance first wrought this second great genius into operation, he was equally an original as the first. For, whoever considers the process of the operations of intellect, and the origin and progress of knowledge, will find it difficult, if not impossible, to mark what that spring, internal or external, is which first becomes a cause from a coincidence of ideas that gives course to it.

As it hath become an almost generally received opinion, that the instauration of true philosophy in the present age derives its source primarily and solely from Bacon the lord St. Albans, I cannot but think it just in this paper to endeavour to restore to the *first original* that portion of merit which is due to him; and fairly to appreciate the former, without derogating from the latter: and to recommend to this society to trace back the origin of their philosophy to a more remote source, arising within the bounds of the county in which this society is established*; from a spring which, however *illaudatus*, unhonoured, and almost lost in antiquity, will always be a peculiar honour to this county, as generally so, in every extent and degree, to the British nation at large.

Almost all societies, originally from superstition, but since from the habit of custom, have adopted some supposed patron saint. Instead of adopting a patron, let this society avow as their pattern the philosopher monk. Though no saint, it would be an honour to any philosophic society to adopt his *principles*, and to follow his example.

1st, To adopt his principles by an independent spirit of philosophizing, which will not be repressed or kept down by the authority of any name howsoever great; will not be restrained within the bounds of any society or sect howsoever respectable; will not submit to any dominant lead, but, without opposition or faction against others, will unabated follow the steps of truth with undeviating investigation; by an ar-

* Roger Bacon was born near Ilchester.

dour which knows no repulse, yet with an humility of diffidence which knows no presumption.

2dly, By a temper which repels every tincture of fashion howsoever honoured by the times or consecrated by antiquity, *consuetudinis diuturnitate*.

3dly, By a judgment which, whilst it respects the experience of mankind, despises the prejudices of the vulgar, great or small.

4thly, By a true pride, which, conscious of what it is capable of, knows how to commence its first steps to knowledge, by feeling and acknowledging its ignorance; and not by a false shame attempting to hide it, and with a still more ridiculous vanity labouring to clothe it in the semblance and under the garb of learning. Of this tribe of learned gentlemen our monk says, "*Apparentia solum tenet eos, non curant quid sciunt; sed quid videantur scire coram multitudine infensatâ.*"

Having thus adopted his principles, let us *follow his example also* in the mode of philosophizing; 1st, By a patient induction and cautious combination of particulars, without being hasty to form them into systems on the first flattering semblance of discovery: 2d, That we do not suborn assumed experiments to bear false witness to supposed facts; but to take more merit from the truth discovered than from the discovery; and to eradicate, if it be possible, all vanity from the heart, *et veritatem sine dote quærere*.

Lastly, It will not be beyond the scope of this paper, and, I would hope, not offensive to this learned society, to suggest, whether amongst their other learned studies and philosophical researches there may not be many a commenced, though interrupted, institute of experiments; many a glimpse of discovery not yet brought out to open day in the works of this great original philosopher, well worth their attention for examination at least: yet

Non jurare in verba magistri.

I shall not here take notice of the discovery of lenses, nor of their first uses in magnifying objects, and particularly as reading-glasses; because the refraction and reflection of light, and of the rays of the sun, by lenses and mirrors, were known to the antients*, though I do not meet with any mention of their use to aid in *reading*. But I believe the antients wrote in such uncials as suited the powers of the eye without this aid. Another reason why I do not take notice of this as a discovery to be imputed to Bacon is,

* Vide Scholiast to the Nubes of Aristophanes.

that

that he mentions the power and operations of glasses on light, (if I * remember and understand him aright,) rather explaining these operations already in use, than as a discovery made by himself. I think, however, that it is clearly a fact, that, like Sir Isaac Newton, and like our Herschel, the honour of the present age, he made those arrangements which produced the telescope; and that, like them, he applied his improvements to astronomical observations. He particularly mentions a previous trial which he made, as our common mechanic opticians do, of reading small writing at a very great distance.

I do not mention the discovery of *gunpowder* as imputed to our monk, because, although he † gives the mode of making this powder; and describes its explosive and coruscant power; and clearly points out that he had in his mind a destructive use to which it might be applied in *comburation*, made to burn at a great distance: yet he withholds himself from explaining *this use*; and does not in any part mention its explosion, as applied by the *instrumentality of tubes* to a projectile force that was to throw the missile weapons of cogles or balls. Which application of it renders it specifically *gunpowder*. His words are: "In omnem distantiam, quam volumus, possumus artificialiter componere *ignem comburentem ex sale-petra et aliis.*" What these other articles are he mentions in another part of his works, namely, *sulphur* and *charcoal*.

I cannot refrain myself from mentioning the idle traditional story of friar Bacon's *brazen head*, which was to speak and announce time, because I think it founded in a real though mistaken fact. From considering what one may elicit out of the nonsense of it, I have persuaded myself that it was an experiment in horology, and the model of a clock measuring time by the oscillation of a pendulum, and by various movements in *the face* of this head, (as is actually the existing fact in the clock at Basse,) marking the divisions of time, together with a mechanism that should announce by sound those divisions, which, in allusion to the *face* and *head*, was called speaking; similar to the crowing of the cock on the clock at Strasbourg, or to the cuckoo on the wooden clocks which the Germans sell about our streets.

There remains still to be mentioned, incontestably to his unrivalled honour, that he was the first discoverer of the error of measuring time by a false period of the year; and the first projector of the reform of the calendar and other

* Removed from my books, I quote from memory.

† In his tract *De Secretis Operibus Artis et Naturæ*.

tables of time, founded on his own astronomical observations; which reform he proposed to pope Clement V. It was the fate of this proposal to be neglected; whilst the imperfect Gregorian reckoning, which it hath been found necessary since to correct, was adopted. I will close this paper with a translation of the words of Dr. Jebb, the learned editor of the *Opus Majus*, as they stand in his preface:—"The proposal made by Bacon to the pope Clement was one of the noblest efforts of human industry: considered in all the circumstances under which it was framed and composed, it is one of the most stupendous instances of the force of human genius which hath been recorded; and will do honour to our learned countryman as long as the sun and moon endure."

LVII. *Observations which seem to prove the Necessity of observing and meditating a long Time before any decisive Opinion is formed in Philosophy in general, and particularly in regard to the Cause of Earthquakes. By COUREJOLLES*.*

HOWEVER painful may be the researches necessary for discovering the causes which Nature employs in her operations, we must observe with great attention and indefatigable assiduity in order to collect those facts which are properest for conducting us to the attainment of this object. It does not belong to men to invent causes; they exist in nature, and it is their business to discover them.

If in the exact sciences the precision of a result escapes us, and if we cannot extend our conception but to that term where incommensurability of dimensions stops calculation, how can the creators of systems pretend to the privilege of penetrating to the bottom of the abysses where Nature has concealed her primitive causes? Nothing then but experience, observation, and comparison, guided by geometrical method, can conduct us with wisdom in our researches.

Sensible of this truth, I have thought it my duty to follow this progress in my observations on every thing that may relate to the cause of earthquakes; for it would be imprudent to assign one before a variety of facts are established. This method is the more certain, as Nature often spontaneously unveils herself: but a long time is necessary to collect good observations: and we ought never to be precipitate in making them appear, because in the study of the sciences there is an age at which the passions blind us by a too ardent desire

* From the *Journal de Physique*, Pluviose, an. 10.