BERNARD BLACKSTONE
Τακτικοῦ καθηγητοῦ τῆς ἕδρας Βύρωνος
Ἀγγλικῆς Φιλολογίας καὶ Λογοτεχνίας

L'ESPRIT GÉOMÉTRIQUE

L'esprit géométrique n'est pas si attaché a la géométrie qu'il n'en puisse être tiré, et transporté à d'autres connaissances. Un ouvrage de politique, de morale, de critique, peut-être même d'éloquence, en sera plus beau, toutes choses d'ailleurs égales, s'il est fait de main de géomètre. L'ordre, la netteté, la précision, l'exactitude, qui règnent dans les bons livres depuis un certain temps pourraient bien avoir leur première source dans cet esprit géométrique qui se répand plus que jamais, et qui en quelque façon se communique de proche en proche même à ceux qui ne connaissent pas la géométrie. Quelquefois un grand homme donne le ton à tout son siècle ; celui à qui on pourrait le plus légitimement accorder le gloire d'avoir établi un nouvel art de raisonner, était un excellent géomètre.

FONTENELLE, *Préface, Histoire de l'Académie royale des sciences depuis le règlement fait en 1699.*

The excellent geometer of whom Fontenelle speaks, the man who gave its tone to a whole century, is of course Descartes. Descartes stands for the 'new philosophy' in Europe; an English critic, tracing the growth of the 'geometric spirit' in his own country, and its effect on English life, thought, and art, might have pointed to Bacon as the initiator: Bacon, whose *Advancement of Learning*, which appeared in 1605 (thirty-two years earlier than the *Discours de la Méthode*), calls for an application of mathematical technique to the problems of morality. But of course Descartes remains the significant figure; for not only was he himself a mathematician of genius, but he developed in the *Discours* the theme of the relationship of geometry to other branches of knowledge, and of its overruling importance as the very foundation of epistemology:

> Ces longues chaînes de raisons toutes simples et faciles, dont les géomètres ont coutume de se servir pour parvenir à leurs plus difficiles démonstrations, m'avaient donné occasion de m'imaginer que toutes les choses qui peuvent tomber sous la connaissance des hommes s'entre-suivent en même façon, et que, pourvu seulement qu'on s'abstienne d'en recevoir aucune pour vraie qui ne le soit, et qu'on garde toujours

l'ordre qu'il faut pour les déduire les unes des autres, il n'en peut avoir de si éloignées auxquelles on ne parvienne, ni de si cachées qu'on ne découvre. Et je ne fus pas beaucoup en peine de chercher par lesquelles il était besoin de commencer, car je savais déjà que c'était par les plus simples et les plus aisées à connaître ; et, considérant qu'entre tous ceux qui ont ci-devant recherché la vérité dans les sciences, il n'y a eu que les seuls mathématiciens qui ont pu trouver quelques démonstrations, c'est-à-dire quelques raisons certaines et évidentes, je ne doutais point que ce ne fût par les mêmes qu'ils ont examinées [1], bien que je n'en espérasse aucune autre utilité, sinon qu'elles accoutumeraient mon esprit à se repaître de vérités et ne se contenter point de fausses raisons.

This is a modest enough application ; later in the *Discours* Descartes explains how he came to see that geometry was not merely a *discipline* but a *method* which could be applied to philosophy itself. It is from *axioms* similar to those used in mathematics, i.e. from truths whose self-evidence is guaranteed by their clarity, that we can begin to build our system. The existence of God himself is demonstrated on geometrical lines :

...je voyais bien que, supposant un triangle, il fallait que ses trois angles fussent égaux à deux droits, mais je ne voyais rien pour cela qui m'assurât qu'il y eût au monde aucun triangle ; au lieu que, revenant à examiner l'idée que j'avais d'un être parfait, je trouvais que l'existence y était comprise en même façon qu'il est compris en celle d'un triangle que ses trois angles sont égaux à deux droits, ou en celle d'une sphere que toutes ses parties sont également distantes de son centre, ou même encore plus évidemment : et que, par conséquent, il est pour le moins certain que Dieu, qui est cet être parfait, est ou existe, qu'aucune démonstration de géométrie le saurait être [2].

These are but two citations from a work which must be read in its entirety by anyone interested in the relations of mathematics and philosophy in the seventeenth century ; and they are sufficient to establish that Descartes' position was as pre-eminent at the beginning of the century as Newton's was at the end. It is interesting to note that if it was a Frenchman who inaugurated the reign of the geometric spirit, it was in France too that this spirit was first criticised [3].

---

1. i.e. 'qu'il était besoin de commencer'.
2. Cf. later, John Wallis's demonstration of the Trinity.
3. Pascal begins his *Pensées* (Section I, Différence entre l'esprit de géométrie et l'esprit de finesse) : 'Et aussi il est si rare que les géomètres soient fins et que les fins soient géomètres, à cause que les géomètres veulent trai-

Fénelon again, writing to the Duc de Chevreuse, warns him against 'this craving for geometrical certainty' where the delicate springs of faith and grace are involved. God's will can work only in a fruitful obscurity, 'the deep darkness of faith and supernatural things'. It is not until 1710, with Berkeley's *Principles of Human Knowledge,* that we find any suggestion from an English writer that all is not as it should be.

Let us for the moment glance once again at our first passage from the *Discours*. Passing over the presupposition expressed in the first sentence that 'everything which falls within man's knowledge' is arrived at as the end product of a 'long chain of simple reasons', let us note the emphasis placed upon the *certainty* of mathematical demonstration. Descartes was by no means alone, nor was he the first, in feeling the attractiveness of this. With the departure of the old certainties — the Ptolemaic universe, the unity of faith, the belief in authority — the certainty of mathematics was coming to seem the last hope. It was on mathematics that men were now hoping to construct a new world-picture. Geometry was the key to the universe. It is a far cry from the Council of Laodicea which, 'in the year 364, in the 36th Canon, excommunicates any Clergymen, that should be *Magicians, Inchanters, Mathematici,* or *Astrologers*' [1], to the *Theologiæ Christianæ Principia Mathematica* of John Craig in the year 1699, or Glanvill's assertion in 1668 [2] that geometry 'is so *fundamentally useful a Science,* that without it we cannot in any good degree understand the *Artifice* of the *Omniscient Architect* in the composure of the *great* World, & *our selves.* ΘΕΟΣ ΓΕΩΜΕΤΡΕΙ was the excellent saying of *Plato;* & the *Universe* must be *known* by the Art whereby it was made' [3].

ter géométriquement ces chose fines, et se rendent ridicules, voulant commencer par les définitions et ensuite par les principes, ce qui n'est pas la manière d'agir en cette sorte de raisonnement'.

1. *An Historical Essay concerning Witchcraft,* 1718, Francis Hutchinson, chapter XIII.

2. *Modern Improvements of Useful Knowledge,* a book which summarises the progress of science in the seventeenth century with particular reference to the part played by the Royal Society. It is a controversial work written in answer to personal attacks upon Granvill by a rabidly Aristotelian clergyman.

3. Glanvill's admiration for Descartes is unbounded. In his book, he expatiates, after a discussion of the improvements in chemistry and anatomy, on 'the inimitable *Des Cartes*', who 'hath vastly out-done both former and

The *Discours* explicitly rejects the use of authority in philosophical reasoning, to replace it by the *certain* demonstrations of mathematics. And the rejection became universal. Even the pious Sir Thomas Browne, whose ambition in *Religio Medici* was to 'follow the great wheel of the Church, by which I move, not reserving any proper Poles or motion from the Epicycle of my own brain', in *Pseudodoxia Epidemica* spurns authority in favour of mathematical demonstration :

> Unto reasonable perpensions it [authority] hath no place in some Sciences, small in others, and suffereth many restrictions, even where it is most admitted. It is of no validity in the Mathematicks, especially the mother part thereof Arithmetick and Geometry. For these Sciences concluding from dignities and principles known by themselves, receive not satisfaction from probable reasons, much lesse from bare and peremptory asseverations. And therefore if all Athens should decree, that in every triangle, two sides, which soever be taken, are greater then the side remaining ; or that in rectangle triangles the square which is made of the side that subtendeth the right angle, is equall to the squares which are made of the sides containing the right angle : Although there be a certain truth therein, Geometritians notwithstanding would not receive satisfaction without demonstration thereof. 'Tis true, by the vulgarity of Philosophers there are many points beleeved without probation ; nor if a man affirme from Ptolomy, that the Sun is bigger then the Earth, shall he probably meet with any contradiction ; whereunto notwithstanding Astronomers will not assent without some convincing argument or demonstrative proof thereof [1].

Here of course Browne is not saying anything very startling, nor does he allow his desire for demonstration in 'philosophy' to persuade him that it may be demanded in other spheres of human experience; nevertheless we cannot miss a certain ring of triumph and congratulation in his expression of a truth which was not quite so self-evident to the seventeenth century as it is to us today.

One of the most remarkable of Browne's contemporaries, Sir Kenelm Digby, also pays his tribute to mathematics in his *Two*

---

later times, & carried *Algebra* to that height, that some considering men think Humane Wit cannot advance it further...'.

1. *Pseudodoxia Epidemica*, I, vii. Cf. *ibid.* I, ix, where Browne cites the Bible as giving $\Pi = \frac{21}{7}$: 'But Archimedes demonstrates in his Cyclometria, that the proportion of the diameter, unto the circumference, is as 7 unto almost 22... Now if herein I adhere unto Archimedes who speaketh exactly, rather then the sacred Text which speaketh largely ; I hope I shall not offend Divinity : I am sure I shall have reason and experience of every circle to support me'.

Treatises (1644). Following a discussion of the various branches of learning — discourse, logic, grammar, rhetoric and poetry — he adds:

> There still remaineth one art, not yet spoken of, which knoweth not where to challenge a place. whether among the moderatours of our owne actions, or among those whereby we gouerne things: and that is *Arithmetike*: which seemeth to belong vnto thinges, and yet it meddleth not with them: and againe, it seemeth to be a maine directour of our internall actions, and yet belongeth neyther to *Morals*, nor to *Logike*. Wheresoeuer its due be to place it, I am sure it is not to be forgotten; seeing it is so principall a one, as our life can hardly consist without it. It worketh vpon notions that are no where; for euery thing that is in the world, is but one; and to be, or to make a number, can not happen without an vnderstanding: the affections likewise of them, are as the subject, all inuisible; as to be euen or odde, to be cubes, squares, rootes, &c: and yet how great the power and extent of this art is, none can rightly vnderstand or beleeue, but he that hath the knowledge of it, or hath seene the vertue and efficacity of it [II, cap. iii].

Digby, we note, does not accept quite so whole-heartedly as most of his contemporaries the universal application of mathematics — it 'belongeth neyther to *Morals*, nor to *Logike*'. He was a rebel and an eccentric, in his philosophy as in his life; and his philosophical works never received the attention which they deserve. But he was an acute thinker; and in pointing to the paradox inherent in the nature of mathematics — 'it worketh vpon notions that are no where' — he anticipates the radical criticism of Berkeley. Yet he too admired mathematics for its achievement of demonstrative certainty, and compares it favourably to the jarring schools of philosophy:

> Excepting Mathematikes, lett all the other schooles pronounce their owne mindes, and say ingenuously, whether they themselues beleeue they haue so much as any one demonstration, from the beginning to the ending of the whole course of their learning. And if all, or the most part, will agree that any one position is demonstrated perfectly, and as it ought to be, and as thousands of conclusions are demonstrated in Mathematikes; I am ready to vndergoe the blame of hauing calumniated them.

We shall not be surprised, therefore, to find Digby establishing the basis of his own philosophy on a mathematical principle, that of *quantity* 'and its first differences'. He proposes, in thoroughly Cartesian fashion, 'to begin with the consideration of those thinges, that are most common and obuious; and by the dissection of them to ascend by orderly degrees and steppes (as they lye in the way) vnto the examination of the most particular and remote ones'. Quantity, he says, is the most obvious and the most fundamental notion attached to a body; let us have done with the 'current explanation by faculties', wich leads nowhere, and attempt to arrive at 'Elements, which are the primary and most simple bodies in nature'. (These elements, it should be said, are as different from the four Aristotelian ones as they are from the three Paracelsan principles: Digby has in mind a thoroughly 'scientific' and mathematical idea which indeed anticipates the definition given by Boyle in *The Sceptical Chymist*).

Again, in his discussion of what Bacon called the 'idols of the market-place', the confusions wrought in philosophy by *words*, we find Digby's criticism taking a mathematical turn. Words cause us to suppose diversity where there is really unity, or unity where there is diversity. 'Wordes do not expresse thinges as they are in themselues, but onely as they are painted in the mindes of men'. And as they are painted in the minds of men things become disintegrated into an unreal multiplicity:

> It will not be amisse to illustrate this matter by some familiar example. Imagine I haue an apple in my hand: my eye telleth me it is greene or red: my nose that it hath a mellow sent: my taste that it is sweet, and my hand that it is cold and weighty. My senses thus affected, send messengers to my fantasie with newes of the discoueries they haue made: and there, all of them make seuerall and distinct pictures of what entereth by their dores. So that my Reason (which discourseth vpon what it findeth in my fantasie) can consider greennesse by it selfe, or mellownesse, or sweetnesse, or coldnesse, or any other quality whatsoeuer, singly and alone by it selfe, without relation to any other that is painted in me by the same apple: in which, none of these haue any distinction at all, but are one and the same substance of the apple, that maketh various and different impressions vpon me, according to the various dispositions of my seuerall senses: as hereafter we shall explicate at large. But in my mind, euery one of these notions is a distinct picture by it selfe, and is as much seuered from any impression or image made in me, by a stone or any other substance whatsoeuer, that being entire in it selfe and circumscribed within its owne circle, is absolutely sequestred from any communication with the other: so that, what is but one entire thing in it selfe, seemeth to be many distinct thinges in my vnderstanding.

And hence, Digby concludes, the danger of hypostasising these qualities in separation.

I have quoted this passage at length, not only because Digby's work is so little known, but also for the mathematical basis of its argument, and as an illustration to which I would like to refer later on in discussing the influence of 'l'esprit géométrique' on literature. For the moment it will be sufficient to point out the extreme, almost Cartesian clarity of the style, and the use of geometrical imagery — 'circumscribed within its owne circle' — for purposes of illustration.

'A second error', Digby notes in the margin, is 'the conceiuing of many distinct thinges as really one thing':

> As for example : looking vpon seuerall cubes or dyes, whereof one is of gold, an other of lead, a third of yuory, a fourth of wood, a fifth of glasse and what other matter you please ; all these seuerall thinges agree together in my vnderstanding, and are there comprehended vnder one single notion of a cube ; which (like a painter that were to designe them onely in black and white) maketh one figure that representeth them all. Now if by remoouing my consideration from this impression which the seuerall cubes make in my vnderstanding, vnto the cubes themselues, I shall vnwarily suffer my selfe to pinne this one notion vpon euery one of them, and accordingly conceiue it to be really in them ; it will of necessity fall out by this misapplying of my intellectual notion to the reall things, that I must allow Existence to other entities, which neuer had nor can haue any in nature.

'From this conception, Platos Idæas had their birth...' Reality, in other words, is a matter of *counting* : we know that there is one apple, that there are five cubes, by ticking them off on our fingers : and to whatever cannot be counted by the touch of a blind man the name of reality must be denied. Digby even seems prepared in this passage to renounce the use of general terms ; Aristotle's categories as well as Plato's ideas go by the board, as was noted by that acute if crotchety old critic, Alexander Ross, in his *The Philosophical Touchstone* (1645)[1]. And as we follow Digby further into the maze of his argu-

1. Discussing the *Two Treatises* in the Dedicatory Epistle he refers to Digby as 'that ingenious rather then (in this Discourse) judicious Knight... who, breathing now in a hotter climate, cannot digest the solid meats of *Peripatetick* verities, which hitherto have been the proper and wholsome food of our Vniversities ; and therefore entertaines us with a *French dinner* of his owne dressing, or with an aerie feast of *Philosophicall quelque choses :* a banquet fitter for Grasshoppers and Camelions, who feed on dew and aire, then for men, who rise from his Table as little satisfied, as when they sate downe. We that have eat plentifully of the sound and wholsome viands which are dressed in *Aristotle's kitchin,* are loth now to be fed, as the *Indian gods* are, with the steem or smoak of meats ; or, as those

Umbræ tenues, simulachraq ; luce carentum,

those pale ghosts in *Proserpine's Court,* to champ Leeks and Mallowes'.

ment, we perceive how from the mathematical he proceeds by inevitable stages to the mechanical position : how growth is to be explained mechanically, and how the forms of living things are to be accounted for by the rules of proportion and the laws of motion on strictly non-vital principles :

> And thus it appeareth how an account may be giuen of the figure of the leafes, as well as of the figure of the maine body of the whole tree : the little branches of the leafe, being proportionate in figure to the branches of the tree it selfe (so that each leafe seemeth to be the tree in litle ;) and the figure of the leafe depending of the course of these litle branches, so that if the greatest branch of the tree be much longer then the others, the leafe will likewise be a broad one : so farre, as euen to be notched at the outsides, round about it, in great or litle notches, according to the proportion of the trees branches. These leafes, when they first breake out, are foulded inwardes ; in such sort as the smallnesse and roundnesse of the passage in the wood through which they issue, constrayneth them to be ; where neuerthelesse the drynesse of their partes, keepe[s] them asunder ; so that one leafe doth not incorporate it selfe with an other : but as soone as they feele the heate of the sunne (after they are broken out into liberty) their tender branches by litle and litle grow more straight ; the concave part of them drawing more towardes the sunne, because he extracteth and sucketh their moysture from their hinder partes into their former, that are more exposed to his beames ; and thereby the hinder parts are contracted and grow shorter, and those before grow longer. Which if it be in excesse, maketh the leafe become crooked the contrary way ; as we see in diuers flowers, and in sundry leafes during the summers heate : wittenesse, the yuy, roses full blowne, tulipes, and all flowers in forme of bells ; and indeed all kindes of flowers whatsoeuer ; when the sunne hath wrought vpon them to that degree we speake of, and that their joyning to their stalke, and the next partes thereunto, allow them scope to obey the impulse of these outward causes. And when any do vary from this rule, we shall as plainely see other manifest causes producing those different effects, as now we do these working in this manner.

So too, Digby tells us, with the formation of fruits : their shapes and structures are given them by purely external mechanical forces, and not by any 'intrinsicall formatiue vertue'. Moreover, 'out of these and such llke principles a man that would make it his study with lesse trouble or tediousnesse, then that patient contemplator of one of natures little workes (the Bees) whom we mentioned a while agone, might without all doubt trace the causes in the growing of an Embryon, till he discouered the reason of euery bones figure ; of euery notable hole or passage that is in them ; of the ligaments by which they are tyed together ; of the membranes that couer them ; and of all the other partes of the body'.

This ingenious account[1] of the mechanical processes we call growth is repeated in *A Discourse Concerning the Vegetation of Plants. Spoken by Sir Kenelm Digby at* Gresham College, *on the 23 of* January, *1660. At a Meeting of the Society for promoting Philosophical Knowledge by Experiments. London 1661.* He gives an account, from hearsay, of Palingenesis — the recovery of a plant from its ashes — and discusses the question whether such a process would be 'a true *Palingenesis* of the original Plant'. He decides in the negative :

> For speaking rigorously, I cannot allow Plants to have Life. They are not *Se Moventia,* They have not a principle of motion within them. It is the operation of outward Agents upon them, that setteth on foot all the dance we have above so heedfully observed, and which so near imitateth the motions of Life.

But why, one wonders, should Digby confine his denial of life to plants ?

The answer to the *Two Treatises* had already come in Nathaniel Highmore's *The History of Generation* (1651). He gives a whole chapter of quotation from Digby, including his theory of growth, on which he comments :

> How much the Conceipt subverts the antique principles of Philosophy, I shall not here undertake to demonstrate : How far it shoulders out Truth it selfe, and so blots out those indeleble Characters, fixt by the finger of the Creator on every species ; those inscriptions on all his works, the distinct constitutions, parts, operations, and figures (which are so many Bushes, or Signes hung out, to discover what are the inhabitants within) will easily shew us. For if heat rarifying a substance, making it thrust it self into a larger space were the sole author of all generation ; and were the cause why Plants grow up in stalk and leaves, and downwards in root : we must either admit these differing Characters to be vain accidental chances, or else look out for some other agent, from whose fruitful womb, this variety might spring forth.

Not confining his argument to the point that Digby's theory overthrows the doctrine of signatures (still almost universally believed in at this date) Highmore attests the great variety of vegetable forms :

> This grows up with a square stalk, that with a round ; some start up hexangular, others triangular... with leaves round, jagged, indented, scollopt, or the like : as may be seen in several Plants, inhabitants of

1. Which Locke did not disdain to borrow, without acknowledgement, in the *Essay Concerning Human Understanding.*

the same piece of ground, under the same Heavens, inviron'd with the same Air, and heavenly influences. These distinct figures cannot spring from the cold circumstant Air ; for this applying it self alike to all, and every side of these ascending parts, should equally compresse every part ; and so all Plants should sprout up cylindrical, as the Trunks of Trees do.

Finally Digby's mathematical mania is shown up for the absurdity it really is :

If we examine his first principle, *viz.* That the several figures of Bodies, proceed from a defect in one of the three dimensions ; caused by the concurrence of accidental causes ; we shall find it extreamly straightning the most delightful variety of the Creation, and the infinite power of the Creator. For upon these grounds it must be supposed, that the most perfect figure is to be cubal, and all Bodies should have been cast into that mould, but that some external causes stepping in, hinder almost all from obtaining that perfection : the Creator not being able to withstand their prevalency ; or by patching up that defect, could not give perfection to all that, which his own mouth assures us was good.

So great was the importance and popularity of mathematics by the middle of the seventeenth century, that it would scarcely be an exaggeration to say that it had much of the prestige, as a polite accomplishment, enjoyed by music in the sixteenth century. A smattering of mathematics, and sometimes more than a smattering, was the mark of a *virtuoso.* Speaking of 'the General Artist' in *The Holy State,* Fuller remarks : 'Mathematics he moderately studieth to his great contentment, using it as ballast for his soul, yet to fix it, not to stall it ; nor suffers he it to be so unmannerly as to jostle out other arts'. The eccentric knight Sir Thomas Urquhart invented his own system in *Trissotetras* (1645), and in praise of Napier, the inventor of logarithms, cries : 'I am infallibly perswaded, that in the estimation of scientifically disposed spirits, the philosophers stone is but trash to this invention, which will alwayes, in their judicious opinions, be accounted of more worth to the Mathematicall world, then was the finding out of America to the King of Spaine...' Mathematical and astronomical imagery makes its way into the most emotional parts of his ΕΚΣΚΥΒΑΛΑΥΡΟΝ, as in this extraordinary description of the charms of Crichton's mistress :

...the eyes of the Prince's thoughts... pryed into, spyed, and surveyed from the top of that sublimely-framed head... down along the wonderful symmetry of her divinely-proportioned countenance... and from thence through the most graceful objects of all her intermediate parts, to the heaven-like polished prominencies of her mellifluent and heroinal breast, whose porphyr streaks, like arches of the ecliptick and colures, or Azimuch and Almicantur circles intersecting other, expansed in pretty veinelets, through whose sweet conduits run the delicious streams of nectar wherewith were cherished the pretty sucklings of the Cyprian goddesse, smiled on one another to see their courses regulated by the two niple-poles above them elevated, in each their own hemisphere...

Turning to less exotic but even nobler spheres of society, in which Cambridge Platonism in the person of Henry More shakes hands with high politics in the persons of the Earl of Conway and his lady, Anne Finch, we find the claims of mathematics still more strongly supported. Conway 'was an early member of the Royal Society, and a reader of Descartes long before Cartesianism had become popular in England; in the midst of affairs of state, he set himself to study Euclid' [1]. On September 20, 1651, we find him writing to his daughter-in-law:

Philosophy doth treate of things in the Heavens or the Earth, by Number and Measure, or by the consideration of theire Qualities. That Mathematiques and Naturall Philosophy was very early in the world is very cleare. Musique cannot be but by Mathematiques. Neither can the Digging, Melting and preparing of Mineralls be without the knowledge of the Mathematiques and Naturall Philosophy, neither can the ordering of Cattell according to theire natures be without Naturall Philosophy... Beside this we have a cleare knowledge that Geometricall proportions were soone knowne by the description of the Arke commanded to Noah [2].

Anne Conway herself, in the midst of acute physical distress, determined to learn arithmetic and 'studied Euclid with a tutor when she could not master it alone' [3]. And in March 1658 Henry More writes to her: 'I heare by Mr Hyrne what a quick proficient your Ladiship is already at Mathematicks' [4].

---

1. *Conway Letters*, ed. by Marjorie Hope Nicolson (1930), Prologue, p. 6.

2. *Conway Letters*, pp. 34 - 35.

3. *Ibid*, Prologue, p. 49.

4. The study of mathematics had been suggested to Lady Conway by her brother John Finch, who had advised her not to go beyond the first six books of Euclid, which will be sufficient to make her 'Capable of anything in Astronomy or Opticks, or morall Philosophy'. *Op.cit.*

More's own view of mathematics is mystical and occultist. We sense the *Timæus* and Pythagoras behind such a statement as this:

> Now for the Mysterie of Numbers, that this ancient Philosophy of Moses should be wrapped up in it, will not seem improbable, if we consider that the *Cabbala* of the *Creation* was conserved in the hand of *Abraham* and his family, who was famous for *Mathematicks* (of which *Arithmetick* is a necessary part) first among the *Chaldeans*, and that after he taught the *Aegyptians* the same Arts, as Historians write. Besides Prophetical and Aenigmatical writings, that is usual with them to hide their Secrets, as under the allusions of *Names* and *Etymologies*, so also under the adumbrations of *Numbers*, it is so notoriously known, and that in the very Scriptures themselves, that it needs no proof; I will instance but in that one eminent example of the Beast 666 [1].

Note once again the necessity felt by many of the wilder speculators of the age to fly to Moses's skirts when they lay themselves open to attack from the quarter of the Church or of science. The Cabbala is not very respectable, but Exodus is. Did Moses teach the Egyptians mathematics, or learn from them? The question can be endlessly debated; but that Moses was a mathematician is as certain as that Solomon was, in Browne's phrase, 'that great Botanologer'. More's last sentence leads us into the thought of Sir Isaac Newton.

It is to More's friend Glanvill, rather than to More hinself [3], that we must turn for what is perhaps the key passage on the *beauty* of mathematical forms as they appear in nature. The passage has an obvious bearing on the late seventeenth century taste for what is regular, and its aversion from the rude and uncultivated: a taste which it was to hand on to the eighteenth century, and which was to reign almost unchallenged until the Romantic revolt. The paragraph comes from the *Lux Orientalis* (1662).

> I appeal to any man that is not sunk into so forlorn a pitch of Degeneracy, that he is as stupid to these things as the basest of Beasts, whether, for example, a rightly-cut *Tetrahedron*, *Cube* or *Icosaedrum* have no more *pulchritude* in them, then any rude *broken stone* lying in the field or high-ways; or to name other *solid* Figures, which though

---

1. *The Defence of the Threefold Cabbala* (MDCLXII), Preface.

2. The study of mathematics had been suggested to Lady Conway by her brother John Finc, who had advised her not to go beyond the first six books of Euclid, which will be sufficient to make her 'capable of anything in Astronomy or Opticks, or morall Philosophy'. *Op.cit.*

3. More gave up his early Cartesianism when he came to disagree with Descartes' idea of spirit.

> they be not Regular, properly so called, yet have a settled *Idea* and Nature, as a *Cone, Sphear* or *Cylinder*, whether the sight of these do not gratifie the minds of men more, and pretend to more elegancy of shape, then those rude cuttings and chippings of *free-stone* that fall from the Mason's hands... And it is observab[e, that if Nature shape any thing near this *Geometrical* accuracy, that we take notice of it with much content and pleasure [1] : as if it be but exactly *round*... or ordinately *Quinquangular*, or have the sides but *Parallel*, though the *Angles* be unequal, as is seen in some little stones, and in a kind of *Alabaster* found here in *England* ; these stones, I say, gratifie our sight, as having a nearer cognation with the Soul of Man, that is Rational and Intellectual, and therefore is well pleased when it meets with any outward Object that fits and agrees with those congenite *Ideas* her own nature is furnished with. For *Symmetry, Equality*, and *Correspondency of parts*, is the discernment of *Reason*, not the Object of *Sense*, as I have heretofore proved [II, v. 5].

Glanvill a little later develops this hint of the geometrising power of the soul :

> ...our *souls* use a kind of *Geometry*, or *mathematical* Inference in judging of external objects by those little hints it finds in *material impressions*. Which *Art* and the *principles* thereof werc never received from *sense*, bnt are presupposed to all *sensible perceptions*. And, were the *soul* quite void of all such *implicite notions*, it would remaine as *senselesse* as a stone for ever... Also we find in our selves *mathematical notions*, and build *certain demonstrations* on them, which abstract from *sense* and *matter*. And therefore never had them from any *material* power but from something more sublime and excellent.

Here we find Glanvill using the notions of geometry to support the spirituality of the soul and the existence of innate ideas. He is probably the last scientific or philosophical figure of any eminence to feel able to do so. The tide was setting towards the Lockean synthesis which was achieved in 1690. Already Hobbes had told us that 'there is no conception in a man's mind which hath not at first, totally or by parts, been begotten upon the organs of sense' ; and Locke was to elevate this opinion into a dogma. But the existence of God and the truths of religion could still be proved and illustrated by mathematics as we shall now see.

Newton, in a letter to Bentley (1692), explains that he had a religious motive in writing his *Principia* :

---

1. Glanvill may be thinking here of Browne, who observes in the *Garden of Cyrus* 'how nature Geometrizeth and observeth order in all things'.

> When I wrote my treatise about our system I had an eye upon such principles as might work with considering men, for the belief of a Deity ; and nothing can rejoice me more than to find it useful for that purpose.

In later letters he presents the picture of God the Great Mathematician, exciting admiration by the orderly beauty of His equations :

> To make such a system with all its motions, required a cause which understood, & compared together the quantities of matter in the several bodies of the sun and planets and the gravitating powers resulting from thence... and to compare and adjust all these things together in so great a variety of bodies, argues that cause to be not blind and fortuitous, but very well skilled in mechanics and geometry.

In the same year that Newton was writing this, another eminent mathematician, John Wallis, D.D., Professor of Geometry at Oxford, published his *Theological Discourses Containing VIII Letters and III Sermons Concerning the Blessed Trinity*, in which he uses the analogy of a *cube* to explain his august subject :

> Suppose we then a Cubical Body (which what it is, every one knows, that knows a Dy.). In this are *Three Dimensions* (Length, Breadth, and Heighth) and yet but *One Cube*. Its Length (suppose between East and West) *AB*. Its Breadth (suppose between North and South) *CD*. Its Heighth (between Bottom and Top) *EF*. Here are *Three* Local Dimensions, truly Distinguished each from other (not only imaginarily) : The distance between East and West (whether we think or think not of it) is not that between North and South ; nor be either of these that between Top and Bottom. The Length is not the Breadth, or Heighth ; the Breadth is not the Length, or Heighth ; and the Heighth is not the Length, or Breadth : But they are *Three* Dimensions truly distinct each from other : Yet are all these but *One* Cube : And if any one of the *Three* were wanting it were not a Cube. There is no Inconsistence therefore, that what in one regard are *Three* (three Dimensions) may, in another regard, be so united as to be but *One* (one Cube). And if it may be so in Corporeals, much more in Spirituals.

This curious rewriting of the Athanasian Creed in laud of the Holy Cube continues with a supposition of the three dimensions infinitely extended : thus we have three infinite dimensions, and yet but one Infinite Cube. Moreover, the three dimensions can but three, for three suffice to take up 'all imaginary space'.

> I say further, If in this (supposed) Cube (we suppose in Order, not in Time) its first Dimension, that of Length, as *AB*, and to this Length be given an equal Breadth (which is the true generation of a Square) as *CD*, which compleats the square Basis of this Cube ; and to

> this Basis (of Length and Breadth) be given (as by a further Procession from Both) an equal Heighth *EF*, which compleats the Cube; and all this eternally (for such is the Cube supposed to be), here is a fair Resemblance (if we may *parvis componere magna*) of the Father (as the Fountain or Original;), of the Son (as generated of him from all Eternity;) and of the Holy-Ghost (as eternally Proceeding from Both;) And all this without any Inconsistence...

In Letter III Wallis tries to answer the objection that 'Since the Three Person cannot be Divided; How is it possible, that One of them can Assume Humanity, aud not the other?' He answers, not very successfully, that 'the Persons are Distinguished, though not Divided'.

> Tis asked further, How I can accomodate this to my former Similitude of a Cube and its Three Dimensions... I say, Very easily. For it is very possible, for one Face of a Cube, suppose the Base (by which I there represented the Second Person, as Generated of the Father), to admit a Foil, or Dark Colour, while the Rest of the Cube is Transparent; without destroying the Figure of the Cube, or the Distinction of its Three Dimensions, which Colour is adventitious to the Cube. For the Cube was perfect without it, and is not destroyed by it. Which may some way represent Christ's *Humiliation*. Who being *Equal with God,* was *made Like unto Us,* and *took upon him the Form of a Servant,* Phil 2. 6, 7.
>
> So that, upon the whole Matter, there is no Impossibility in the Doctrine of the Incarnation, any more than in that of the Trinity...

Letter IV passes happily from the field of Christology to that of psychology: 'Thus in *one Cube* there be *three Dimensions*, length, breadth, and thickness. So the *Understanding*, *Will*, and *Memory*, in one *Soul*'. But we may now with advantage leave Wallis's cube and turn to a still more erudite exponent of the relations between mathematics and religion. John Craig's *Theologiæ Christianæ Principia Mathematica* (London, 1699) is obviously writteu in emulation of Newton's great work, and is probably the most curious treatise on its subject in existence. Craig's aim is to enlist Geometry in the service of Divinity. *Vana enim*, he writes in his *Præfatio ad Lectorem, est illa Philosophia, quæ nos ad Naturæ ejusque Autoris cognitionem non deducit; & jejuna admodum est illa utriusque cognitio, quam aliundè quàm ex Geometria haurire operamus... Idque eo magis necessarium mihi videtur, quanto graviores jam contra Religionis nostræ veritatem sunt Atheorum & Deistarum impetus...*

Craig anticipates criticism from those who think his way of defence may do more harm than good. Christianity stands on such sure foundations, they will say, that it is *res Christianismo indigna* to attempt to show its *probability*. But Faith is itself *illa mentis persuasio, quâ, propter media ex probabilitate deducta, quasdam propositiones veras esse credimus*. So, after answering two more objections, Craig proceeds to his definitions.

There are ten of these, the first five dealing with Pleasure ('voluptas') and the last five with Probability. Pleasure is defined as 'that sweet sense of the mind produced in us by objects suited (*convenientia*) to our human nature'. Intensity of Pleasure is its magnitude as determined by the magnitude of this sweet sense of the mind; its duration is the quantity of time this sense persists in us. The equability and uniformity of the pleasure are next defined. We have a 'scholium', and pass on to Probability, defined as 'the appearance of suitability or unsuitability of two Ideas, in arguments, whose connexion is not constant, or at least not perceived to be such'. Natural Probability is deduced from our own experience; historical probability from the testimony of others. 'The Suspicion of historical probability is the motion of the Mind into contrary parts of history'. And so on. Craig is attempting a mathematics of religious assent and dissent. His definitions are followed by Axioms, three in number: 1) 'Every man strives to produce pleasure in his mind, to increase it, or to remain in a state of pleasure'; 2) the wise man strives in a ratio with the true values of his expectations; 3) the foolish man strives in the contrary ratio.

Chapter one, following these preliminaries, deals with 'historical probability as oral tradition'. There are three aspects of this which lessen its probability. First, the number of witnesses or sponsors through whom the tradition has been handed down. Secondly, the distance of the place where the events occurred, but this only affects traditions the principal subjects of which are still extant. Thirdly, the length of time through which the tradition has been handed down. All this is developed in a series of 'propositions' and 'theorems'. With the aid of diagrams, and with evergrowing complexity (involving square roots and minus quantities) the fifteen propositions lead up to this final one: *Quando evanescit probabilitas cujusvis Historiæ (cujus subjectum est transiens) vivâ tantum voce transmissæ, determinare.*

The second chapter deals with the Historical Probability which is transmitted by *written* Testimony. Here there are six Propositions with their attendant Problems and Corollaries and Scholia. Proposition XVI, Problem IX is as follows :

To determine the quantity of historical probability [in testimony] first written down by one historian.

Let z be the integral probability of the History at the beginning of the publication of the first copy, n the number of copies, T the time, aud D the distance of the place, by which the written History is transmitted. And let f be the suspicion raised by the transcription of any copy... let q be the 'known suspicion': then the probability will be:

$$P = z + (n-1) \times f + \frac{T^2\ k}{t^2} + \frac{D^2\ q}{d^2}$$

Five more Propositions follow, then this Conclusion:

I believe I have now sufficiently and clearly explained all those things which are necessary to the determining of historical probability. I now proceed to the second part of my subject, that is, to defining the Magnitudes of Pleasures. For Pleasure is the one principle of all our actions and strivings *(conatum)*. Whatever we do or suffer, whatever we desire or shun, all undoubtedly comes to pass by reason of Pleasure. In order therefore that men may pursue their pleasures prudently, it is necessary that they should seek to determine their *(earum)* magnitudes and values accurately: and this will be taught in what follows.

But we shall not pursue Craig into the even greater intricacies of his evaluation of Pleasures. To the connoisseur of such things his book will be interesting and valuable as a precursor of the theories of the Utilitarians (though he puts his system to a quite different use). What I have managed to say about Craig will suffice to show his work as the *reductio ad absurdum* of the *esprit géométrique* of the century which he brings so ponderously to a close.

BERNARD BLACKSTONE

ΣΥΝΤΜΗΣΕΙΣ ΒΙΒΛΙΩΝ ΤΙΝΩΝ ΚΑΙ ΠΕΡΙΟΔΙΚΩΝ ΜΑΚΡΟΤΙΤΛΩΝ

1) Ἑλληνικά

ΔΙΕΕ = Δελτίον Ἱστορικῆς καὶ Ἐθνολογικῆς Ἑταιρείας.
ΕΕΒΣ = Ἐπετηρὶς Ἑταιρείας Βυζαντινῶν Σπουδῶν.
ΕΕΚΣ = Ἐπετηρὶς Ἑταιρείας Κρητικῶν Σπουδῶν.
ΕΕΦΣΠΑ = Ἐπιστημονικὴ Ἐπετηρὶς Φιλοσοφικῆς Σχολῆς Πανεπιστημίου Ἀθηνῶν.
ΠΑΑ = Πρακτικὰ Ἀκαδημίας Ἀθηνῶν.
ΠΡΑΑ = Πραγματεῖαι Ἀκαδημίας Ἀθηνῶν.
ΜΕΕ = Μεγάλη Ἑλληνικὴ Ἐγκυκλοπαιδεία τοῦ « Πυρσοῦ ».

2) Ξενόγλωσσα

BZ = Byzantinische Zeitschrift.
JHS = The Journal of Hellenic Studies.
PW = Paulys Real - Encyclopädie der Classischen Altertumswissenschaft (ἐκδόται μετὰ τὸν Pauly καὶ Wissowa, οἱ Wilhelm Kroll, Karl Mittelhaus καὶ ὁ νῦν προάγων τὸ ἔργον Konrat Ziegler. Εἶναι ἐκτενὲς καὶ θεμελιῶδες ἔργον διὰ τὴν ἑλληνικὴν καὶ λατινικὴν φιλολογίαν).
REG = Revue des Études Grecques.

3) Ἱστορία τῆς Φιλολογίας

Bursian, Karl, Geschichte der classischen Philologie in Deutschland, München und Leipzig 1883 (ἀξιόλογον ἔργον).

Sandys, Sir John Edwin, A History of classical Scholarship, τόμ. 1 - 3, Cambridge 1908 (ὁ πρῶτος τόμος εἰς τρίτην ἔκδοσιν 1921), θεμελιῶδες ἔργον.

von Urlichs, L., Geschichte der Philologie ἐν τῷ πρώτῳ τόμῳ σελ. 33 - 103 τοῦ Handbuch der classischen Altertumswissenschaft τοῦ Iwan von Müller, 2α ἔκδ. München 1892 (ἀξιόπιστος ἔκθεσις καὶ κριτικὸς χαρακτηρισμός).

von Wilamowitz - Mœllendorff, Ulrich, Geschichte der Philologie 1921 (ἐν τῇ Einleitung in die Altertumswissenschaft τῶν A. Gercke καὶ Ed. Norden, τόμ. Α', Leipzig, Teubner 1921).

Ἄλλα ἔργα σημειοῦνται ἐν τῇ ἐκθέσει.