CHAPTER I.

RENAISSANCE METAPHYSICS AND THE HISTORY OF SCIENCE

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I. Throughout the latter half of the sixteenth century John Dee enjoyed a thoroughly European reputation for profound scholarship: his opinions were widely consulted, his authority invoked in many diverse fields of speculation and research. Yet, without minimising the value of his personal influence and attainments, the justification for a detailed study of these must depend less on the limited value of the accompanying attempt to assess Dee's own claims as an original thinker or direct contributor to scientific discovery, than on the fact that he may be significantly considered as the representative — and in some respects the spokesman — of an age. Dee in his life and writings championed a certain vigorous "new philosophy" which flourished in the late Renaissance(1), and though this philosophy, or rather the particular form which it then assumed, fell later into barren obsolescence (2) yet some of its offshoots of that time were to bear rich, and unexpected fruit in succeeding centuries. Dee's surviving works are perhaps only fragmentary illustrations of certain aspects of the general body of doctrine he maintained, yet an examination of them is illuminating since, however limited or idiosyncratic their subject matter, they exemplify a typical approach to various problems, and they also occasionally give clear expression to broad statements of principle, which should, Dee believed, provide a foundation for a multitude of particular applications. In these respects, they throw some light, if only indirectly, on much contemporary endeavour and achievement, even in fields discussed not at all, or only incidentally, by Dee, since these may often properly be regarded as related and comparable effects arising from a common intellectual tradition.

The movement to which Dee contributed may be described rather broadly as striving after a new philosophic synthesis which should fully express and relate, as far as they could be known from the data of reason, revelation, and experience, both the capacities of men and the processes of nature, and which should relegate neither to a subordinate or derivative position in regard to the other. It has a natural place, frequently acknowledged by its exponents, in the general stream of neoplatonism, but it is more particularly associated with that current, which embracing much of later Greek endeavour in astronomy and mathematics, stemmed from Alexandria, notably preserving thereafter, from this source, the characteristic emphasis on the natural powers of the Intellect to arrive at truth, and on the value of dialectic, with the corresponding lack of stress on the immediate importance of "ecstasy" (reflected in the Greek patristic writers' comparative neglect of the doctrines of Original Sin and Grace), and ran through much of the scientific thought of the Arabs; which current, by insisting that the Cosmos was a logical and necessary unfolding of intelligible principles, emanating from and manifesting the nature of God, gave strong support and encouragement to the study of the natural sciences and mathematics. That other aspect of neoplatonism — the only one of much influence in the Latin speaking world during the middle ages, represented by the writings of the Pseudo-Dionysius, and to some extent those of St. Augustine, which stressed, or was inclined to value above all else, the personal mystic experience — to which all knowledge and philosophy was considered at best, merely a propaedeutic, since true knowledge was essentially revealed and not attained to — this aspect was of course incorporated into the scientific neoplatonism of the Renaissance — to have excluded it would have introduced incoherency and inconsistency into a doctrine relying so much on the assertion of the mind's ability, owing to its relationship with the creative thought of God, to determine a priori, at least criteria of, truth. Nevertheless it was overshadowed in the sixteenth century by the rediscovery of, or by the increased attention then given to, the works of later Greek Platonists — the mathematical and metaphysical commentaries of Proclus for example, whose writings make up one of the chief single influences on Dee's thought in general — as well as ancient scientific writings either associated with these, or at least having little relation with and frequently running counter to Aristotelian doctrines — and the theological writings of the Greek Fathers, who presented a much more explicit synthesis of Christianity and pagan philosophy, the essential harmony between which was affirmed by Justus, Clement, Gregory and others, than any of the Latin Fathers had been prepared to do. The form this Neoplatonism assumed and the applications of its doctrines, in the late Renaissance, of which Dee's work is here considered to be representative, and which were to give a new character to the scientific, or philosophical, approach to Nature in his time, bore fruits in fields far removed from Dee's own immediate interests; for while his own practical achievements, in kind and in extent, remained somewhat narrowly limited, the principles from which they sprung, and the method by which they were developed, were widely proclaimed and accepted as possessing universal validity throughout the "natural," "intellectual," and "spiritual" worlds, and as providing guiding canons for practice of the various arts as well as invention or discovery in mechanics and natural sciences.

Not infrequently in recent years, attention has been given to Dee's scientific importance (3), and recognition of this has led to the demand for a re-examination of his work that will once more

accord him "his rightful place as the central figure in the beginning of modern science in England." (4) Dee's historical significance in this sphere is chiefly due to the fact that he became one of the principal propagandists in England for an approach to nature which proved of immense value in the hands of later experimentalists, and laid the foundations of the methods of modern physical science. Yet Dee supported these views not from any intuitive precognisance of the profitable results — their pragmatic justification — which would follow from their extensive application in succeeding centuries, but rather because they formed an intrinsic part of a general scheme of thought, which was largely evolved and defended by as pure an a priori theorising as the most involved logistic subtleties of that earlier scholasticism which Dee's intellectual legatees of the seventeenth century, in conscious superiority, so frequently and vociferously derided. There were other philosophies of the day, seemingly as cogent, offering much greater favourable empirical evidence, than this stubborn assertion of discoverable, all-permeating numerical harmonies which flew frequently in the face of "common sense" in its interpretations of observed fact, and of which the few demonstrable advantages were almost ridiculous compared with the vastness of its pretensions, and though, finally, these rival systems fell into entire discredit it was only because they were found not to be so congruent with the mechanical world, which the later unification of scientific theory, accompanying material progress, seemed increasingly to insist on.

Moreover it is to be observed that many of the apparent eccentricities of Dee's thought, the intricate and unprofitable mazes of cabala and occultism in which he inextricably involved himself, were, in some respects, no more than rigorously derived consequences of the general philosophy he had so heartily embraced; and though this, in other hands, provided the framework for the ordered world of Newton, the watch-universe of Huygens (5), there was not to be found implicit in its premisses, as Dee accepted them, any just cause for an invidious division between mathematical activities concerned with quantitative measurement of natural phenomena, and esoteric numerological fantasy. Those of his contemporaries who achieved a greater measure of practical success, or who did not involve themselves so deeply as Dee in these fields, were men who were more fortunate or less consistent in their employment of the "new" methods. The charge has been too often reiterated that Dee "allowed his imagination to dominate his scientific knowledge, and he adopted the baseless superstitions of the day." (6) Only by an unjustifiable application of the standards of modern knowledge, (7) is it possible to separate as intrinsically different those elements in Dee's work which survived the test of "usefulness" in future generations from those sterile speculations which to him, and to his age, seemed to be fully as necessary in completing a coherent picture of the world.(8)

The Elizabethan World Order, it has been said, "was at once theological, legal, scientific, psychological and moral. It was designed to provide for everything." It was felt as "a poetry at work in the world preparing a grand solution of the problem of human existence," (9) rather than expressed as a formal body of doctrine; and thus, though it embodies specific features possessed of high survival value and considerable fertility, examination of these and the particular systems of thought of the day which produced them, must be conducted with reference to this general background. Moreover, although Dee's works are set, quite consciously, within a fairly clearly discernible philosophic tradition, no one of them sets forth explicitly, in ordered and comprehensive form, a total philosophical system. Whether such an adjective in its modern sense is properly applicable to them is doubtful. Dee for instance seldom touches on epistemological problems; he has made certain assumptions, from which he is inclined to dogmatize about the foundations of knowledge, and seems only ever concerned with the problem of the possible range and extent of its content. Compatible with his assumptions and his efforts to determine these is characteristically an extensive and eager syncretism, in which he attempts to absorb with an almost voracious credulity, vast areas of data and ideas discovered by various recourse to myth, tradition, theology, authority, reason and experience; his criteria of their validity being only the potentialities they may exhibit for being brought into coherent arrangement within a framework whose pattern takes its inspiration from what he believed to be the methods of mathematics and the dialectic of Plato. But such tests he did, with considerable strictness, apply, and thus may be allowed to have followed "the true method of philosophical construction which is to frame a scheme of ideas the best that one can, and unflinchingly to explore the interpretation of experience in terms of that scheme," (10) and his works may be legitimately considered in the light of such an implicit scheme.

That the new science grew up within the confines of a metaphysic is not surprising (11), for one of the most striking characteristics of this metaphysic is its view, radically differing from that of other schools of thought, of the status, functions, and potentialities of mathematics. And mathematical studies stood in dire need of such organised philosophical encouragement and

support. Without it the fulfillment of the rich promises held out by contemporary rediscovery of many ancient scientific works might have been much longer delayed. The difficulties of obtaining adequate instruction in mathematics was a grave discouragement; their study penetrated only slowly and in the face of many obstacles into the curricula of the universities; an established and orthodox Aristotelian science, by relegating mathematics to a wholly inadequate place in the universe of knowledge, provided no inducement to a prolonged and arduous study of them, since it largely denied the prospect of any valuable results to be achieved thereby.

Moreover mathematics still suffered under the unenviable reputation, deeply entrenched in the learned as well as the popular mind, of being a branch of necromancy, or at least of being intimately connected with such forbidden lore in its more recondite aspects. Such suspicions Langland had voiced — the words are supposed to be those of Dame Study — in the fourteenth century:

"As astronomye is an harde thynge and yvel for to knowe,
Geometrie and geomesye is gynful of speche,
Whoso thenketh werche with tho two thryveth ful late,
For sorcerye is the sovereyne booke that to the science longeth." (12)

In Dee's day far from diminishing they had rather, in some respects, increased and become more acute, they were encouraged by the all too easy misunderstanding of the approach to natural magic and theories of ceremonial magic adopted by many of the new school of "neo-Platonic" mathematicians. They survived hardily into the age of Francis Bacon, long after Dee's death, so that after the Savilian and Sedleian chairs had been established in 1619 at Oxford, Francis Osborne records that one effect of the University's encouragement of this study was that "not a few of our then foolish Gentry" thereupon refused to send their sons to it "lest they should be smutted with the Black Art." (13) It was a reputation kept alive by the inevitably somewhat isolated and individual activities of mathematicians, many of whom undeniably engaged in a variety of "magical" practices, in an attempt to attain wider benefits or more concrete results from their study, than it directly indicated.

Of theories recognising the importance of mathematics, it has been acutely observed "Les uns adoptent le mathematisme en considerant d'ou il vient; il ne faut pas les confondre avec ceux qui l'adoptent en considerant ou il permet d'aller." (14) In the sixteenth century the second consideration was perforce still largely a matter of faith, a faith which might be sustained by the promise held out by its supposed importance for ceremonial magic or belief in hidden spiritual knowledge contained in formal numbers, but one which insofar as it related to the physical or applied sciences could be based only on a particular interpretation of a restricted range of data, which opponents had no trouble in discounting. The general defence of mathematics could be far more effectively conducted, therefore, by appealing to the absolute certainty attendant on its demonstrations, its apparently a priori source, and the doctrine that the intellect of man was, in the sphere of pure reason, a reflection of the creative intellect of God (which together may be said, broadly, to make up the argument of Dee's Preface). Since moreover it rapidly became obvious that many conclusions reached in this field were in flagrant contradiction with accepted teachings, or views arising from seemingly natural modes of thought, some such philosophical justification as this was required if the results were to be accepted as a true picture of "reality"; otherwise they could only teach such a lesson in scepticism, with its accompanying lessening of interest, as Montaigne drew from the information that the "certain" logic of geometry had produced the impossible conclusion that lines could asymptotically approach each other (15). An imperfect understanding of mathematical operations, especially as regards their application to physical phenomena, posed questions which demanded answers, seemingly only to be found in non-mathematical fields — even in the solution of simple Archimedean problems of weights and balances difficulties would seem to have been encountered in conceiving these otherwise than as involving the intellectual performance of the, physically, clearly impossible operation of multiplying a "weight" by a "length" — indeed it is very striking how far in needless complication, techniques of calculation, based on "ratio" and proportion went as a rule to avoid such a suggestion when dealing with such problems. It is this inhibition against "mixing" different qualities in the same term that perhaps accounts for the fact that while in certain early thinkers, such as Leonardo, clear and exact statements of lever problems, even of those considering the bent arm lever, and requiring the concept of the "potential arm" are to be found, yet the idea of turning moments about a point, though to us it appears obviously to be already essentially involved in the correct expression, which they had arrived at, of the relationships they were considering and indeed to be only a transformed equivalent of this, is conspicuously absent. Another example is Dee's treatment of problems of medicine graduation in the Preface, in which both measures of volume

and degrees of temperament were concerned, and in which he goes to some lengths, in working them out, to avoid multiplying coefficients of these two distinct "qualities" together.

II. Nor was it possible, as has sometimes been suggested, for the scientist or the artisan of the day merely by purging his mind of the prejudices and distorting theories of the schools and looking on the naked face of nature to make a beginning of "modern science." Such an attempt would have left him destitute of any tools whatsoever for the investigation of nature, and lacking any intelligible "language" in which to co-ordinate his discoveries. For as Jowett wrote, pointing the "positive value" for later ages of the "general notions" provided by Greek philosophy, these are always "necessary to the apprehension of particular facts....Before men can observe the world they must be able to conceive it." (16) The most primitive act of classification by the mind is already an implicit interpretation in terms of an order, which cannot be considered as "given" in that which is classified (17). Though it be allowed that we make contact with the world through "experience," "experience," as a crude datum, is incapable of providing the methods and the controlling scheme for the analysis of itself, by which process alone it is rendered intelligible; indeed some such process, together with the implicit claim that it has been validly and successfully applied is the inescapable if unconscious reference, whenever the term "Reality" is employed with any degree of significance. For "the fact," as soon as it becomes anything above the purely qualitative subrelational intuition, is already theoretically orientated and known only in regard to some context which implicitly determines it. The relations and characteristics which compound its nature become known only as it is ascribed a place in an hierarchical set of concepts and categories — each one of which is in some respects an abbreviation of the total system — in which "experience" is made to participate. "The fact as such reflects, therefore, all the systematic problems of construction and interpretation. And in appealing to facts, we unconsciously appeal, whether we admit it or not, to the systems which are responsible for their formulation, for whatever we know of them we know only in terms of the system we have presupposed." (18) Indeed much of the power, the high survival value of aspects of the "new science" of the Renaissance, results from its development of novel methods of assessing, or rather constructing facts, its establishment of a revolutionary criterion of what should be considered "typical" or of fundamental importance in natural process. But it is to be noticed that although it arrived at this from general assumptions, and with bold confidence, by enormous "extrapolation," was prepared to assert the universal validity of its theories and launch into speculations on how the total workings of the cosmos might be represented on such patterns, nevertheless, the actual range of "experience" that it could immediately deal with and satisfactorily interpret, was at that time considerably more restricted than that which other natural philosophies were able to take into account. It was much more narrowly selective and, many thought, in a highly artificial way, in the data it was able to admit as significant, than were for instance an empirically minded "Naturalist" school or an Aristotelianism with its constant appeal to common sense, which might therefore claim to take their stand on much more solid and extensive "factual" foundations.

The present relevance and importance of this may be more clearly shown by a brief notice of one of the ideal, but self-confessed aims of scientific theory: that is its constant endeavour to reduce itself as far as possible to the form of a purely deductive system. It attempts to render experience rational by interpreting it in terms of laws which are held to possess, or which arise directly from principles possessing, a quality of "necessity." But this "necessity" is a product of the definitions and axioms which form the groundwork of the mental approach, and cannot, logically, be held in any way to be a quality of the sequence of sense impressions which the former are intended to describe approximately, and to account for satisfactorily. The methods which scientific procedure employs to establish "necessary" — and therefore — intelligible relations, reveal this procedure clearly as "an active endeavour to create something, and not a passive endeavour to discover something." (19) The underlying aim emerges strikingly from such classical instances of scientific activity as Fourier's treatment of heat — dominated by the attempt to determine a minimum number of simple "facts" from the scientific expression of which all related phenomena would mathematically be discoverable; or Lagrange's Mechanique Analytique which claimed to do for mechanics what Descartes had effected for geometry, to dispense with all figures, and constructions and exhibit the subject as a branch of analysis; or the same constancy of endeavour exhibited by Maxwell's total achievement, controlled by the explicitly confessed principle that a fact could only be held to be "explained" when it was reduced by analysis to a form in which it could be deduced from the fundamental laws of mechanics (20). From this standpoint, the ultimate problem for contemporary science appears as Sir Edmund Whittaker expressed it as "What are the fundamental data or postulates from which the complete set of laws of the material universe can be deduced by pure mathematics?" (21); while an indication of how far scientists may believe that theory has progressed in this direction is given by Eddington's assertion, in connection with the "Four Constants of Nature," that "ideally they are all that need to be measured, and when

he has supplied us with these numbers, the experimental physicist might retire and leave all the rest of physics to the mathematician." (22)

This tendency to metamorphosize itself into a formally explicit deductive system is probably a feature of all organised and coherent thought. What distinguishes differing systems more particularly are the underlying criteria of intelligibility which inform such systems with the particular characteristics on the grounds of which they are accepted as psychologically satisfactory. Differing but equally ultimate criteria of this kind are represented by magical anthropomorphism, teleology, mechanical causation (as illustrated by Kelvin's declaration that he could only "understand" something when he could build a working mechanical model to reproduce it "right the way through") and, one of the more recent entrants to this class, the Calculus of probabilities. Much of the importance for subsequent scientific development of late Renaissance thinkers lies in their adoption of such criteria, which however archaic in source, were still a revolutionary departure from those of the majority of their more immediate predecessors; in their provision of a philosophical framework which rendered these theoretically acceptable, and which was to allow of a gradual redefinition of scientific method and a reassessment of the foundations of man's knowledge of the external world. The assimilation of the Elements of Euclid — then first disseminated in its complete form — and recently discovered treatises of Archimedes (both of which apparently offered mathematical systems made up of a series of pure deductions which also corresponded, exactly as far as was verifiable, with the presentations of sensible intuition), to a psychology and metaphysic drawn from platonist writings was to prove crucial (23). The methods they suggested commenced a rapid invasion of numerous other fields of thought hitherto considered as quite foreign to mathematics. Thus Cassirer writes: "Mathematics had been an element in culture before the Renaissance; but in the Renaissance with thinkers like Leonardo or Galileo it became a new cultural force. It is the intensity with which this new force fills the whole intellectual life of the time and transforms it from within that we should regard as what is significantly new." (24a) At the same time it may be noted that despite some brilliant individual discoveries, the services of the sixteenth century to pure mathematics lay less in any original work it produced than in vindicating its study and firmly re-establishing its importance — effecting indeed in large measure an entire revaluation of it. Thus, although it has been sometimes pointed out that it was mathematicians of the seventeenth century who first make any considerable advance on the ancient knowledge, that Cavalieri, Barrow and Wallis took up the study of geometry "precisely at the point where the Academy had left off," (24b) yet nevertheless it was an earlier generation that had, by its own faith and enthusiasm, resurrected the ancient achievement, had given it wide currency, and first adumbrated the character and importance of the role it was to play in future thought.

The triumphant, almost unhesitating career, of the methods whose seeds first found generally favourable ground in the thought of the Renaissance is perhaps the outstanding feature of "the modern period." So impressive has it been that it has sometimes been urged that the entire history of thought and science should be interpreted and assessed in relation to the history of mathematics (25), and a plausible defence can be made for Kelvin's statement, that only when a thing can be measured and a number ascribed to it, can it be said that anything may properly be known about it (26). Be the general validity of such views what it may, they undoubtedly reflect the nature of the premisses, which now seem unchallenged in their claim to provide the necessary Archimedean point from which alone Science can effectively survey, and attempt to operate on, the world. "Tout progres important dans la connaissance de la nature," it has been claimed, "etait marque par la conquete d'une decimale exacte de plus," (27) and Poincare, holding firmly that in themselves mathematics were no more than "un language commode," insisted none the less that they must not be considered as a veil set between the mind and nature but were the sole instruments permitting to the mind knowledge of "l'harmonie interne du monde, qui est la seule vertable realite objective." (28) On such standards it is clear that "the discovery of the true relevance of the mathematical relations disclosed in presentational immediacy was the first step in the intellectual conquest of nature. Accurate science was then born," (29) and it is hoped that the following study, by an examination of the thought of a typical 16th century "scientist," may make apparent some important aspects of the contribution of that period to such a beginning.

It is a period somewhat earlier than that perhaps usually given detailed consideration from such a point of view, and still occasionally stigmatised as largely "pre-scientific," yet in the late Renaissance may be observed a growing clearness and exactness in the determination of the direction in which later science was to move. Once begun, its progress is marked by a fine inevitability differentiating it strongly from other historically developing intellectual movements. Thus, to take a striking example, it is difficult to over-rate the importance of Newton's advance in

under-propping the purely kinematic description of the solar system, which was all previous exact science had been able to provide, with an equally exact, related dynamic "explanation." Nevertheless Newton's expression of the law of gravitation can be seen as the solution of a purely mathematical problem, having for its data Kepler's expression of the laws of planetary motion, taken in conjunction with a transformation of Kepler's vague suggestion of a central controlling force into the exact question, what must the nature or magnitude of the action of such a force be, to permit such motions, given the respective masses of the bodies concerned? For two centuries after Newton, advances and discoveries in the study of the mechanism of nature are characterized by their conformity with the original Newtonian schema (30). When a change apparently began with the gradual intrusion into scientific thought of such features as the "stresses in the dielectric" by which Maxwell sought to explain electrostatic attractions but which he confessed himself unable to account for by mechanical considerations, or the necessary introduction in a rapidly increasing number of physical problems of considerations relative to the character of a "field," with its accompanying abandonment of attempts to seek "explanation" in terms of the nature and interactions of the component "entities," these marked, not the failure of the general methods of mathematical analysis which had produced Newtonian thought, but only the outgrowing of the concrete image, the intuitively attractive analogy of "mechanical causation," which had understandably been suggested by the application of these methods in the past, but with which they had no intrinsic connection. The psychological value of such pictures in fostering procedural development has frequently been high, and their interaction with it of utmost consequence, especially in the early stages of any science, but whatever the mental need of them, they become progressively less important, their survival more and more misleading, in a science controlled by a method in which they have no natural place; it is doubtful whether the atom can ever be thought of again under any other guise than that of a set of differential equations or be fitted with any more "understandable" description which it will not immediately repulse. Brief interludes when departments of science have appeared to hesitate in this path, have in their outcome only served to confirm the inevitability of the general pattern. Comte in 1828 haled the rise of an apparently independent and self sufficient chemistry — and biology — as prophetic signs that the tyranny of mathematics over scientific thought, and the metaphysical prejudice that certitude was only to be found in mathematics was approaching its end — or at least discovering its limited validity (31). But in the event, chemistry was more and more driven to seek an explanation for the fundamental operations it sought to account for from a mathematicised physic, and already by the end of the century Karl Pearson was extensively applying mathematical weapons to attack biological questions (32), a procedure thoroughly vindicated by subsequent developments, especially in Mendelian genetics. Today we occupy a world in which the failure of an otherwise adequate principle to account for a residue of 43 seconds of arc per century in the perihelion of Mercury can lead (in conjunction with a few other problems involving data of comparable magnitude) to a radical alteration in our total cosmology; and this in a period when as Hermann Weyl has authoritatively pronounced: "In spite of, or because of our deepened critical insight we are today less sure than at any previous time of the ultimate foundations on which mathematics rests." (33) It is as well, especially when considering the history of science, not to overlook, because of more obvious fundamental differences, such generic similarities as between, for example, the Pythagoreans' postulation of "antichthon," to satisfy the demands of the mathematic pattern they held as underlying the cosmos (34), the modern prediction, in order to bring observed planetary motions into conformity with the laws of Newton, of the existence of Neptune, which was shortly after verified, and the subsequent no less confident prediction of the size and position of the planet Vulcan on precisely similar grounds, a body which had later to be recognised as entirely mythical.

It is in the centuries immediately preceding the age of Newton that we may observe the gradual formation and dissemination of several of the fundamental beliefs — or if one will, conventional assumptions — that have so permeated and coloured later scientific thought, and have provided so many of the categories and relationships through which man has claimed to "understand" — if he did not experience — "reality." Dee, and many of his contemporaries, advocated an approach to nature the rich potentialities of which were only gradually to be revealed, but at the same time, he, as did also somewhat later thinkers in the same tradition such as Kepler or Galileo, largely derived this approach from prior beliefs about the general order of creation, and defended it by a metaphysical evaluation of it. It is necessary to emphasize this, since perhaps no later than the seventeenth century this process had been consciously reversed (35), and thus reversed — a general picture of nature being now "constructed" from the results of the application of some selected method to particular phenomena — was to receive general acceptance as the correct procedural sequence of thought. But when, as it would seem in such cases, metaphysics

are dispensed with, it is usually to be found, as Burtt has pointed out, that what has occurred is merely that, unobserved, some "method" has been surreptitiously elevated to the status of a metaphysic (36); (while the assumption that a given method may be universally applied with unvarying success is already rich in implications about the Real Nature of Things, which follow from the asserted consonancy between things and the particular method). If Newton was able to believe that he "made no hypotheses," it was only because some of what had once been the "metaphysical fantasies" of earlier men, who had insisted on the necessity of replacing a humanly experienced qualitative interpretation of nature by an abstract quantitative one, had then become current and unquestioned coin: an instrument had been transmitted to him, which by then could be seen to produce sufficiently remarkable practical results to secure him from any feelings of a need for a priori certainty as to its validity, or for enquiry into whether it was possessed of a pragmatically respectable provenance (37). None the less, especially when the high reputation of the empiricism of Francis Bacon in this period is remembered, the question remains, as Pierre Boutroux phrases it (while investigating the underlying premise of Newton's thought, "Cet acte de foi dans la valeur des mathematiques") "Comment se fait — il qu'une vue aussi theorique ait ete si facilement acceptee par les heritiers directs d'une ecole de savants qui pretendait repousset systematiquement tous les principes poses a priori?" (38)

These two apparently opposed procedures — the one largely deriving its methods and approach from an acknowledged metaphysic or defending them by reference to it, the other confidently assuming a method and declaring it advances without hypotheses, are however, in reality, closely related, they merge into one another and historically it is usually difficult to distinguish, except very approximately, between them as present in various stages of the total development of a science. Any absolute distinction between them or clear cut discrimination between periods on such a basis is probably only acceptable in the interests of temporary convenience — generally these procedures are co-present, though in constantly varying proportions as regards influence and effectivity. Periods may be more readily distinguished by the change in the consciously acknowledged importance of each. In that form of thought, which from this standpoint usually precedes and contributes to the formation of the special character of the other type of procedure, that is later more generally accepted as correct, some unified Wholeness, an already typified cosmology, which is believed to be, at least in the general principles, already in the possession of the mind, controls and conditions the view taken of the parts, endowing them with their nature and significance by dominating and directing the detailed study of particular phenomena; in the second "modern" procedure, certain initial assumptions are present which define only the type of approach to be made to the parts, the method of approach then reveals aspects of the parts, the particulars it discriminates, which are accepted as primary, and generates in the end an idea of the whole, mediately, through discovered "laws." (These to a strict empiricism may appear as only the statistical grouping of results, but even so it is a grouping under previously chosen headings representing themselves the original determinative assumptions, or analogies, and frequently embodying ideas which impart to such laws a certain formal necessity.) It is clear however that both procedures must ultimately rely on premisses which, unless it is claimed these are to be admitted only in virtue of their material consequences and these in turn regarded as arising only by lucky and unanalysable chance from them — a view powerless to provide or suggest any guide or direction for further investigations, evidently stand in need of further justification and make demand for a foundation which could inevitably only be of a metaphysical type. Though whether in any case such foundation may be adequately supplied has, it would seem, nothing to do with the possible value which may result from their acceptance for thought in general or for scientific theory or practice (39); just as, conversely, though it is possible to pass an historical judgment made in the light of its subsequent developments on the justification, or the limited validity of any particular system arising from either of these procedures, this will usually be based on reasons, and certainly made from data bearing little relation to those which determined its original acceptance. Thus, whatever the particular merits of any system judged from this or any other standpoint, it would seem that, in the final analysis, at the source of even the most rigorously exact science is to be found only the Augustinian affirmation "Credimus ut Cognoscamus."

The close dependence of practice upon theory which is here in question is perhaps best illustrated by the nature of the "experimental method," in the early history of which Dee's Preface holds a not unimportant place. It draws its value, and it is this that distinguishes it from an uncritical contemplation or accumulation of experiences, from the fact that each experiment is envisaged within a coherent framework of theory, might indeed be regarded as merely a testing of the premisses which suggest it. The continual adjustments that result are what redeems the apparently circular course — the "hermeneutic circle" — of theory and observation from

viciousness. Most hypotheses it will be found have died at the hands of their own offspring, that is have been eventually unable to account conveniently for data provided by experimentation which they have themselves conceived. But at all times the significance of the experiment lies in its relation to the theory which has designed it, and it is frequently a complicated artificial construct. A pure empiricism not only could never have lent any assistance to the development of this procedure, but belief in the very doubtful existence of such a form of thought is itself rather to be explained as a historical by-product of the successful application of the experimental method, and of misunderstandings as to its nature. For "at all times is rigorous reasoning, the essence of mathematics, the necessary condition of accurate and fruitful observation." (41) Moreover it is the body of theory, which has been thus organised by reason, that provides a systematic language of relations into which the experimental results may be interpreted and hence co-ordinated and connected. Indeed only through the medium of some such "language," however primitive in terms or structure, however unconsciously employed, can anything of the external world be known or even observed at all; while some particular syntax will provide the fundamental character of any body of thought, from the simplest magical anthropomorphism upwards, that can, in the largest sense, be described as science. Hence it is clear that the type of experimental question put, by itself providing the terms of the answer, conditions the nature of the observations and the type of result, for the form of its expression makes a preliminary delimitation of an area of acceptable "meaningfulness" in which the answer is confined (42). Thus Priestley's largely qualitative observation of his own experiments on air were barren of any "profitable" results, in-so-far as he himself was only able to make use of them to elaborate an outworn phlogiston hypothesis, while those same experiments repeated by Lavoisier to whom they had been described, and subjected to his searching but purely quantitative analysis, led directly to new and important chemical discoveries. Aristotelians in the Renaissance also claimed to "experiment" widely and constantly appealed to "experience" in opposing the theories of the Neo-Platonic Mathematicists. However, it was the devising of means for investigating experience in mathematical terms that was undertaken by various Renaissance theoreticians, that marks the beginning of specifically modern experimental methods. Yet significantly many of the "experiments" figuring, for instance, in the work of Stevin or Galileo, are of a purely "ideal" nature, that is, the conditions of the problem had only to be expressed in the new terms for the result to become immediately evident, without any necessity for an attempt at physical reproduction. Nevertheless, in their logical rigour, and conscious application of carefully designed, clearly understood theoretical tools they are "experiments" in a far truer sense than the practices of the thoroughly empirical and qualitative Averroist medicine which proved one of the chief founts of opposition to the new theories, and to which the teaching of Francis Bacon, with his relegation of mathematics to the role of an occasionally useful, practical auxiliary, is fundamentally far more akin than it is to the intellectual tradition that lies at the central core of scientific development.

Now "the history of science, in so far as it is a history of scientific progress, consists not so much in the progressive accumulation of facts as in the progressive clarification of problems." (43) But the phases in the natural development of a science are not at all reflected in the general formal structure it assumes at a later well-advanced stage, and to investigate its past merely with reference to this standard, exhibiting earlier stages as being in themselves merely primitive imitations of, and partial approximations to, this form, is but high-level teleological fantasy. Poincare's dictum on mathematics may be applied equally to all well-developed, clearly organised systems: "en devenant rigoureuse, la Science mathematique prend un caractere artificiel...; elle oublie ses origines historiques, on voit comment les questions peuvent se resoudre, on ne voit plus comment et pourquoi elles se posent." (44) Moreover basic assumptions, and ways of viewing problems, transmitted by the late Renaissance to later physical science, have been so hallowed by success in action that the original, less pragmatically reputable, motives for their formulation and adoption have been apt to be overlooked or to be dismissed as unworthy of serious analysis. It is perhaps only necessary to instance here Kepler's determined and influential defence of the, empirically unsupported, heliocentric system and his persistent rejection of the more plausible Tychonic compromise, which largely resulted from his ideas of the innate mystical dignity of the sun, and his erroneous identifications of it with the Pythagorean Central Fire; beliefs which suggested his "valuable error" of defining the planetary orbits with reference to the position of the sun, and not as Copernicus had done with reference to the centre of the earth's eccentric orbit. He was upheld through the eighteen years of incessant calculation, unaided by logarithms, leading to his discovery of the elliptical form of the orbit of Mars, and in his insistence on the tremendous importance of the utmost accuracy of observation, by the conviction that thus would be revealed the exact correspondence (that he had first suggested in Mysterium Cosmographicum, 1596)

between the relative proportions of the planetary orbits, and the spheres inscribed in and circumscribing the, to him metaphysically significant, five regular solids (45). Or again, Galileo, despite the air of modernity pervading much of his work, which has won him the appellation of "the grandfather" of modern physical science, indicated quite clearly that it was only the continued "illogical" objections of opponents, that compelled him to a supererogatory search for practical demonstrations in support of a cosmology, of which he was convinced on far other grounds (46).

It is not merely that in innumerable individual cases, "misconceptions," "false analogies," "metaphysical notions" have been the immediate source of particular discoveries, subsequently verified predictions, significant methodological developments (47), but that it is these which have generally contributed the necessary total framework for the mind without which thought could hardly function directedly at all. There is no necessary proportion between the "psychological value" of a hypothesis, which may well be immense, and its "value" as assessed in terms of the extent of verifiable fact it embodies (48), for "the utility of a belief and its validity are independent variables, and erroneous hypotheses are often avenues to Truth." (49) Thus it has been quite properly pointed out that, despite Descartes' rejection of the Harveian circulation of the blood, upon theoretical considerations, and although "Cartesian physiology....is exceedingly poor in direct matter of fact observations...., the framework of the whole is of the most portentous nature and constitutes, indeed, one of the greatest landmarks in the evolution of biological science, and of natural science generally." (50)

Hence it is not merely insufficient but positively misleading to regard any past scheme of thought merely as "un melange de verite et d'erreurs, de resultats positifs fournis par l'experience et de donnees imaginaires enfantees par la speculation; elements disparates dont l'etrange association s'est trouvee favourisee par le demi-jour dans lequel ont forcement vecu et se sont developpes ces corps de doctrine."(51) It deserves instead examination as a total system, of which the active principles may be exposed, and the gradual unfolding of the potentialities it includes exhibited as supplying the logic, and the organic connections of successive scientific discoveries and general advance. Achievements, or branches of study, lying outside, apparently unrelated to, such general systems, have an appearance of isolation, even randomness, setting them apart from the main current of intellectual progress. This is inevitably the case with the work of even the foremost sixteenth century naturalists — Rondelet, Salviani, Gesner, Belon, Aldrovandi (52). It explains also why, after some centuries of professed empiricism, Renaissance medicine had made no significant advance beyond Galen, but developed rapidly when it entered into the sphere of influence of the new metaphysic and set about utilising in its own field the theoretical weapons this had provided for other branches of science. Thus "die neure Physiologie (of the Galilean era) beginnt mit der neueren Mechanik. Die Betrachtung der Naturerscheinungen ruckt vom Objekte zu den Funktionen, von der Statik zur Dynamik."(53) One of the immediate, more famous, fruits that may be claimed here was the discovery of the circulation of the blood, for "it is significant that the question Harvey put was a mechanical one and not a chemical one,"(54) and one in which he was guided to a solution by a quantitative evaluation of the data.(55)

It would seem then illegitimate, for even the History of "Science" as it must be written for any period, to attempt to establish any supposedly essential, or rigidly applied convential, distinctions between experimentally verified conclusions, and the underlying metaphysic, the exploded or abandoned conceptions of nature from which these sprung, and even those other conclusions born of the same parentage which died contributing no issue to a later assemblage of "recognised facts."(56) The error would lie in not making allowance for the distortions produced by our almost spontaneously assumed "Ptolomaic" attitude towards the past; which looking back from the standpoint of a present synthesis, ends by accepting this as a constant pole permitting an evaluation of precedent development according to its degree of apparent conformity with a rectilinear progress in this direction. Though true in certain respects this does not take account of the fact, that the teleological character of mental activity engenders in various periods a diversity of conscious, and conditioning aims which are likely to bear little resemblance to that more unified and permanent end which is gradually emergent from, or rather increasingly defined by, the development of the methodology running through, though differingly viewed within, these past systems. Accepted uncritically, such "Ptolomaicism" results in a confusion of overt, superficial, frequently chance similarities of form with real anticipation, and a failure to detect the genuinely homologous or properly comparable (57). In contrast, it may be confidently claimed that despite the thoroughly remote, or "pre-scientific" appearance presented by much of Dee's work, or many of the subjects which engaged his attention, here may nevertheless be detected in an active form, the germs — "seminal reasons" would have been his own phrase — of much subsequent theory and scientific practice; and discernible as present in a manner in which they are not to be found in

the work of the majority of his predecessors, of contemporary "Aristotelian scientists," or adherents of an empirical but largely magical "naturalism" such as Porta or Cardan, or even in that of such propagandists of utilitarianism as the more "modern" Francis Bacon. However there was perhaps very little in which thinkers such as Dee could claim entire originality. The works of Duhem have ably demonstrated that in almost every respect their views have a long genealogy and had made frequent previous appearances in the history of thought. Nevertheless such appearances as they had made had been sporadic, or partial, represented merely by individual thinkers, or confined in practice, within the narrow bounds of the formal instruction of one or other of the schools — the University of paris did much to preserve and transmit various opinions on physical questions, differing from the traditional Aristotelian ones, which later became of critical importance in the general interpretation of nature — but it was only in the sixteenth century that these views became generally active, and a significant feature in the "climate of opinion." A testimony to this is the close connection they then rapidly established with the activities of the artisan and technical classes of the time.

The historical development of bodies of thought, more especially in scientific fields, presents, in some respects, a not unimportant resemblance to systems of geometry. That is, they may both be viewed as the unfolding of very often elaborate consequences, implicit in an original set of axioms and postulates. These give at first sight the misleading impression of having to do with primitive entities of which they serve to describe certain primary interrelations, and the natures of which might be expected to be known by previous definition. But the attempt so to know them by initial exhaustive description of a kind independent of the operational context in which they are later to figure, is ultimately only pandering to irrelevant demands of intuition. The entities exist only relationally; their "definition" is indirect and retrospective, a result of the total system, which they seemed to assist in generating. Examples are Euclid's attempts at a definition of "a straight line" which by its unsatisfactory uninformative character lured on generations of commentators to vain endeavours to better it, and his failure to relate satisfactorily his particular concept of "parallelism" to such simple previous definitions; the reason for his failure being in both cases that the nature of the entities Euclid tries intuitively to represent emerges only from the totality of operations in which they appear as signs, which totality produces and serves to define a certain type of abstract "space" on which the operations themselves seem to be dependent, but the nature of which is itself nothing more than the sum of the conditions permitting such operations to be performed — in this case a "space" infinite, homogeneous, allowing the transposition, or change in magnitude, of figures without distortion. But the "meanings" of these conditions are in turn only to be found in the operations. However the historical appearance of such an interpretation, especially in so far as it is maintained as being widely applicable, is a very late-occurring phenomenon, indicative of the attainment of a high level of self consciously critical sophistication. A "modern" can write "It is no wonder that the contemporary physicist finds operational conventions lurking within his definitions of physical facts"; (such ultimates as "mass," "energy," etc., on analysis cannot be shown to denote anything but various theoretical or laboratory "operations") "physical theory has never been anything else than this elaborate and ingenious code of regulations defining how anyone may undertake the imitation and analysis of experimental procedures...It is not a definition of the processes which constitute Nature."(58) At the same time it is obviously not at all necessary to adopt such a theory in order to contribute valuably to progress in fields of which this theory offers quite fundamental reinterpretation; especially is it an outlook very foreign to those Renaissance philosophers in whose work one may detect the first tentative formulation and application, of various axioms of approach and the presence of certain presuppositions that were to play so large a part in the growth of science. They relied on metaphysical doctrines, or the presence of "clear and distinct ideas" to provide foundations for their axiomatic beliefs, to render intelligible the elements these seemed to have reference to and resolve such questions as the "nature of number," and so to justifying their methods of analysis. The philosophy which performed this momentous function for the Renaissance, as the type of Neoplatonism to which Dee subscribed, and if any attempt at a neatly concise summary finds itself continually baffled by its occasionally confusing lack of apparent order, the extensive and indiscriminate nature of its contents, the diversity of materials which it found itself able unperturbedly to find room for, the relatively wide range of standpoints it could adopt on varying questions yet it is this very breadth and flexibility that provides, in some measure, a clue to its strength and contributed largely to its historical value. It must be remembered in considering this rich confusion that although it drew much inspiration from, and founded itself in part upon mathematics, this is not one of those well-organised, logically developed philosophical systems — Spinoza's, or Leibniz's for example, which seem inevitably to arise in those times when some

special branch of mathematics attaining a successful, well-developed maturity, in that form provides — in a very thorough and profoundly significant sense — a "model," but is a body of thought in which a new, almost rudimentary mathematics was able to find a congenial place, where nourished and protected, the vigorous development it was capable of, when so assisted, and for which the time was ripe, could occur unimpeded.

III. Before the detailed examination of Dee's writings and activities which illustrate, though often only fragmentarily, this sixteenth century neo-platonism, it may be desirable to construct a more synthesized representation both of it and older doctrines which it graduatlly superseded, which while emphasizing those features chiefly relevant to the present purposes will locate them in their general intellectual context. Such pictures are inevitably artificial and over-simplified, and in exhibiting the main lines of thought of a period must inevitably diverge widely from, or surpass in completeness, diagrammatic clarity, or development of implications, the explicit position admitted by any particular thinker. Their justification is the provision of an initial approximate perspective framework, which can be later modified and corrected in accordance with the demands of any set of concrete details which may be arranged within it. Here they may assist also in the realisation of how it was that so many of the principles and conclusions drawn from these, and so many of the experiments, of the "new philosophy," which today may seem obvious to the point of being self-evident, could then appear revolutionary, far fetched, or absurd — almost the whole of Galileo's work might be taken to illustrate this theme. They may also help to explain the apparent paradox that though it can well be claimed that for classical thought it was Aristotelianism that provided a practical instrument for the organisation of man's experience of the external world, and encouraged, by its scale of values, assisted by its methods, the study of the natural sciences, in which Platonism seemed to have little interest, yet in the Renaissance the roles played by types of philosophy, still validly distinguishable as Aristotelian or Platonic, had, as regards their influence and effects in this field, been exactly reversed.

One important oversimplification necessarily made here must however be initially noticed, to obviate serious distoritions in the impression such an analysis might otherwise appear to be aiming at as regards the actual intellectual situation in the Renaissance. This is the omission in the interests of clarity, of any assessment here of the wide-spread effects of what was rather an outlook, or tendency of thought than a uniform body of doctrine, sometimes termed "naturalism," which penetrated, and sometimes wholly informed the work of thinkers who professed adherence to any oneof the rival schools — as Gremonini or Pomponazzi among Aristotelians, or Bruno and Campanella — while its permeation of certain departments of Dee's thought will be very obvious in later chapters. Building on what was often presented as an extreme empiricism which dispensed with the fictionalized abstractions through which various philosophies viewed the world ordering and evaluating its contents in advance, it was marked by a prodigious credulity and lack of critical spirit towards its data that effectively prevented, since its extreme tolerance inhibited the development of any useful standards of discrimination, any detailed satisfactory system being formed to account for the mass of facts it initially accepted. Rejecting as false the a priori simplification, the reduction of their concrete experiential richness in the interests of intelligibility and of representing them in a manageable form, of particular occurrences, rejecting also the theoretical standards of the typical or the truly causal advanced by the various schools, naturalism was essentially irrational in a fashion which Aristotelianism, Platonism or mathematicism could not be accused of being. By accepting all marvels which seemed to be wekk attestedm as natural products they ended by destroying any clear ideas of natural laws, and also, an important religious consequence, of the miraculous. It was in some respects a protest against that dualism on which both the schoolmen's Aristotelianism and a later mechanical philosophy insisted, and by which alone such systems attained and preserved their "rationality," but a dualism which had also involved the separation or even opposition of the moral consciousness and Nature. But the Nature to which all things on the position rejecting this distinction, were to be ascribed, proved incapable of definition, because its limits could not be laid down. Pantheism and panpsychism were the inevitable consequences. Overall unity was attained by referring all things to the operation of such entities as the World Soul; only in so far as it adopted astrological doctrines into its system did naturalism in any way preserve ideas of law and regularity in nature that were accessible to verification or observation by man, these indeed often provided the common ground where it made contact and fused with the new scientific thought (59). At a lower level practically all explanation was perforcedly in terms of "occult causes"; natural operations could only be conceived of as "magical" in character and, significantly, magnetic phenomena are conceived by thinkers like Cardan and Pomponazzi adopting such a standpoint as the typical exemplar of all causal action in nature, as a symbol providing a general pattern by analogical extension. Such thinkers claimed to be thoroughly experimental in their manner of investigation but even so, as is the case with Porta in his Natural Magick, they were inevitably preoccupied solely with the examination and discovery of isolated, for them unrelatable individual mirabilia. The immense range of such supposed facts they collected and their open-mindedness to these (60) is illustrated by the vast number of prodigies that are this starting point, the data the work sets out to explain, of Pomponazzi's de Incantationibus,

originally written as an answer to a Paduan physician who had submitted a number of puzzling cases — of patients cured of burns or erysipelis "solis verbis et carminibus" etc. — and to show the naturalness of all such happenings. This feature indeed provides a sharp contrast with the extreme selectivity as regards typical data, of the new science in regard to certain fields where it was successfully able to insist on quantitative observations and mathematical investigation solely — the minute number of cases for instance upon which Stevin and Galileo were able to found the whole structure of a mechanics — indeed a chief contributary to the power and later influence of the science of the Renaissance, in the development of which Dee assisted, was the restricted number of phenomena thoroughly analysed which formed its fcore and from which ground it gradually, thereafter, irresistably conquered increasingly extensive surrounding areas of experience (61).

IV. The revival of Aristotelian doctrines led by Aquinas and Albertus Magnus had been of incalculable benefit to pre-renaissance thought. Opposing the tendency to regard the natural world as merely an agglomeration of largely disjunct symbols, expressing moral or theological truths, it had re-established it as a worthy object of study in its own right. Holding that to differing fields of speculation pertained, particular and independently valid methods of enquiry, it relieved the stultifying pressure produced by the attempt to make continuous reference at each point to theological standards, and to bring all knowledge into too immediate and unequivocal conformity with them. Its teachings on the status of universals and on the function of "illumination" had, in contrast to Anselm's position, insisted on the necessity of admitting observation as an original datum for the discovery of truth in many departments of knowledge, instead of merely stigmatising it as a very fallible operation that might sometimes be usefully employed to illustrate truths which the intellect was able quite independently to attain, without recourse to any assistance from the senses. Of the defects of the preceding Augustinian Platonism, Mandonnet writes: "Les inconvenients etaient dans la methode peu didactique, visant a la speculation ideale en negligeant les donnees experimentales de la science, et utilisant la raison et la foi sans definir sufficamment leur domaine," and while here there was an "absence d'une distinction formelle entre le domaine de la philosophie et de la theologie, c'est a dire entre l'ordre des verites rationelles et celui des Verites revelees," for the Thomists "l'objet de la science et celui de la foi sont strictement definis, et declares irreductibles l'un a l'autre et les traites de science pure executes sans toucher jamais a une question theologique."(62)

Truth, it has been said, emerges more readily from error than from confusion. Aristotelianism provided a method of analysis and an orderly framework for the rational correlation and interpretation of natural phenomena. Taken as "an example of a majestic inductive generalization appealing to the obvious facts, and neglecting the welter of minor differences, Aristotle's general conception of the physical universe remains unsurpassed. For every feature in it there is an appeal to observation, and for every observation to which appeal is made there is the possibility of indefinite repetition."(63) As a detailed illustration: "La theorie du lieu naturel, telle qu'Aristote l'avait proposee, etait une bonne theorie de Physique, car, au moyen d'un petit nombre d'hypotheses elle permettait de classer une multitude de phenomenes connus, de prevoir une foule de repos ou de mouvements."(64) It thus represents a step forward in the unification of the world through the mediation of general concepts and natural "laws." In many respects — the instance above is a noticeable one — its potentialities had been fully exploited in a period prior to the Renaissance, and it became more and more inadequate as a means of fruitfully resolving problems, and problems which to a large extent it may be said to have originally been itself responsible for revealing and clarifying. Its gradual, sometimes piecemeal abandonment, was not the result of any direct refutation. The rise of the new scientific methods and physical theories is rather an indication of the way in which "ideas which make sense in one age, in illuminating and co-ordinating its intellectual experience, do not necessarily make sense in the same way in another. Therefore there is likely to be a shift in the philosophical analogies which will commend themselves as self-evident in different periods of thought."(65) The scientific "neoplatonism" of the Renaissance was not a single coherent body of doctrine suddenly set up in formal and total opposition to previous thought; it made considerable efforts to incorporate with a minimum of change as much as possible of earlier findings and theory, particularly in various sciences such as medicine; it is characterised, rather, by a change in standpoint, and a change in the distribution of emphasis as regards the relative importance and priority of various aspects of knowledge.

Some typical features of Aristotelian thought reveal clearly the causes of its increasing inadequacy or irrelevancy for the scientific demands of the Renaissance. It had sought to categorise and explain the natural world in terms of the qualitative experiences of the normal man, taking the complex and dangerously uncoordinated syntheses made with a deceptive appearance of "naturalness" and "inevitability" by common sense, as simple and fundamental. "It is the familiar," Aristotle had declared flatly, "that is intelligible."(66) A general process of extrapolation based on ideas of the "familiar" produced such assertions as that the earth can be nowhere except at the centre of the world, because it would clearly sink to that place were it ever anywhere else, since "only a careless mind would not wonder at the suggestion that though a small piece of earth falls if unsupported, if one held the whole earth in the air and let it go it would not move"(67); a view reflected by the argument Galileo puts in the mouth of Simplicius; that the acceptance of Copernicus' theories would mean the subversion of the fundamental criterion of Natural Philosophy — since "Sense and Experience" must always be taken as guides. But checked rather than assisted by the way these were interpreted by Aristotelianism, that is in terms which possessed much superficial plausibility and immediate appeal but were internally extremely

complex and refractory to further analysis, the Renaissance was to find that more abstract concepts were not merely more useful in practice but intellectually more simple and satisfactory.(68)

Aristotelianism provides a sharp contrast with what is perhaps the central most fundamental procedural assumption of Platonism, which, insisting that "knowledge" of things is dependent on and determined by the reason, ascribes "Reality" and "Being" to these in the degree to which they manifest "intelligibility," and therefore regards their essence as produced by the same principles from which true discursive reasoning proceeds, which principles forming a hierarchy of more and more generalised "truths" are to be attained by employing discourse reflexively to reveal its own structure; meaning therefore, as a result of such an analysis of discourse is resolved into coherency, and the conditions under which a proposition is admitted as intelligible within the systems are also taken as the grounds for any predication of "existence." In contrast with this approach Aristotelianism presents a "meroscopic" view: the principles of discursive knowledge are held to be undemonstrable, and intuitive, no metaphysical significance is consciously granted them, they have no synthetic content, reason is not productive or formative but only a method of ordering previously known facts and special sciences have particular principles, produced, or at least determined, as it were from below, by the particular nature of the subject matter with which they deal. The world is built up of original atomic facts to which, rather than to the generalisations to be obtained from them by reason, "reality" is to be ascribed. But in regarding the concept as something obtained merely by "abstraction," from things themselves, a priori assumptions, in a particularly vicious form because unobserved, have been made, for the concept has already been essentially presupposed in the generalisation that selected the group of "similar" things from which it is to be abstracted. But the drawbacks are concealed, some immediate advantages obvious. It is an attempt to save the appearances by departing from experience as little as possible. A "copy" theory of knowledge results: a noumenal reality is constructed closely analogous to a selected range of perceptions and employed to account satisfactorily for appearance (69). From the confused flux of sense data are to be extracted a set of qualitative manifolds which, granted unity, necessity and permanence, will form the basis of knowledge, which could not be built merely on the succession of appearances of things "which are subject to change and never remain in the same state."(70)

The standard of objectivity is here thoroughly qualitative, and ultimately unintelligible. For while Platonism tended to regard the thing only as existing in, as generated by, a context of ideas which allowed of a complete rational analysis, here substantiality is prior to formula, things are set beyond the mind and given independent status in themselves, since they have essences, which are what each thing "is said to be per se," "what a thing is said to be of its own nature"; and though this essence is expressed by a definition (71), the elements, or qualitative simples which the definition uses are themselves unanalysable further, they are entities existing beyond the scope of definition: "we cannot say what silver <u>is</u> though we can say that it is <u>like</u> tin."(72)

The multitude of "forms" which compound the world may be classified in a manner that reflects Aristotle's biological predilections — they are arranged, not causally related. Methods which attempt a more fundamental correlation of phenomena, seeking thus to unify the mass of disparate, independent irreducible qualitative fragments which form the unexplained explanation of Aristotelian nature, are rejected or denigrated. Physics and sciences employing mathematics are declared not to study "being <u>qua</u> being" for quantity as applied to things is always changing, and itself is only "notional," which quality is not "sweetness such as it has never yet changed, and that which is to be sweet is necessarily of such a nature."(73) But "there is nothing permanent in respect of quantity....It is by the form that we recognise everything,"(74) and thus "Essence depends upon quality and this is of a determinate, whereas quantity is of an indeterminate nature."(75)

Despite its appearance of continual reference to concrete externals, there is truth in the charge so frequently made by seventeenth century thinkers that Aristotelianism really dealt with words not things. For the justification of its analysis of reality rests heavily on the assumption that there is direct access to facts through language — or rather a certain way of using language. For truth is not sought as in a Platonic dialectic, by an examination of the forms in which language conditions the discriminations and evaluations made by the mind, which its analysis of the interrelations of ideas amounts to, but is supposedly reached by an uncritical acceptance of the false objectifications which occur in its everyday use. "Names" it is argued stand for "passions of the soul," which are "images of things" and "the same for all men." They must be accepted as having one, or a limited number of meanings, for "if they have an infinite number there can be no discourse, for not to have one meaning is to have no meaning," and this single meaning is supposed to have a qualitative, perceptible nonrelational reference, which when definable, is taken

as expressed by that definition, as being what the word was "intended to mean" (e.g., "man," "two-footed animal")(76). The complex of qualities that names so definable denote is held to be not a mere summative plurality but a genuine unity (77). It is as "wholes" that essences have reality, since they can apply to an indefinite number of discrete particulars, and the qualities by which such particulars are distinguished from each other are sharply differentiated in status from those making up the features they have in common; they are labelled "accidental — that which is not necessary or usual,"(78) but the "necessity" is of course, merely given by the defined name; which is in turn only allowed to be known from the things themselves (while the word "usual" indicates the inadequately critical foundations on which this division of natural appearances rests). For while it is strongly asserted that things are not merely collections of accidents — that there must always be something primary, relatively unchanging, to serve as a genuine subject in predicative statement (79), the criteria serving, by the instrumentality of defined forms, to distinguish the accidental from the essential features of a thing are drawn from the contents of an average educated perception presented in, and conditioned by, normal linguistic usage.

The picture thus offered of reality might be compared to a map which eschewing abstract symbolism indicates towns, forests, escarpments, etc. by miniature, only slightly formalised, representations of them all: it makes a certain appeal to the imagination, what information it offers is readily intuitively laid hold on, but it obscures many essential connections. Thus the belief that all true causality was to be found in quiddity, and that the technique of syllogistic reasoning accurately symbolized the rationalism underlying physical process, meant that the middle term of syllogism became confounded with what was causative in Nature (80), and the implication of a consequence seemed therefore identical with the mechanical production of an effect (Socrates, it is concluded is mortal since he is a man, his being "man" is therefore the cause of his death). The type of thought resulting from this hypostatising of the qualitatively definable concepts — which function as formal causes — and its disadvantages for the new science is well illustrated by a passage from Robert Recorde's Castle of Knowledge (81). Recorde, a coadjutator and friend of Dee's, here offers instruction in astronomy to a scholar who, apart from mathematics, seems already to have received a fairly good education, possibly a university one, along traditional lines. After dealing with the daily movement of the sun, Recorde is about to describe the annual motion producing the variation in the time it is above the horizon on successive days throughout the year, but the scholar breaks in. "Yet the reason of that is easy enough to be conceaved, for when the daye is at the longest, the Sonne must needes shyne the more tyme, and so must it needes shyne the lesser tyme, when the daye is at the shortest: this reason I have hearde many men declare." This, comments Recorde, may well be called a crabbed reason "for it goeth backwards lyke a crabbe," and proceeds to enquire further from his scholar of the cause of the longer or shorter days, and is answered "I have heard wise men say, that Sommer maketh the longe dayes and wynter maketh the longe nyghtes."

This passage is part parody, but it points to a genuine danger. Aristotle had declared that "it is impossible for the same attribute at once to belong and not to belong to the same thing and in the same relation,"(82) but the significance of the final all important phrase, could easily be overlooked, particularly after a thoroughgoing objectification of quality. If hot and cold were to be conceived as opposing, mutually exclusive substances, it became a real problem as to how different things might be respectively warmed or cooled by the same breath. Nevertheless, employing such an approach, an orderly and imposing scheme of nature had been already constructed by the time alternative philosophies began to make their appearance in the Renaissance. It referred constantly to experience, and attempted experiment. The type of experimentation it gave rise to and the conclusions drawn from them are illuminating. It could be demonstrated sensibly (i.e., by touch) that water was colder than the surrounding air, or when turned to ice was colder than the air it had frozen in, and exposed in winter cooled below the level of coolness perceptible in its container. This "intrinsic reduction," was ascribed to "the form" of water by Avicenna, and with more verbal precision to its "virtual frigidity" by Albert of Saxony (83). Again if two open vessels of water were taken, and one of them stood on a fire until its contents boiled, and then both were placed in the snow, the boiling water, it was maintained, might always be observed to freeze sooner than the cold water (a consequence of the rapid evaporation of much of the boiling water) which experimentally confirmed the prediction which could rationally be drawn from accepted physical theories, that the natural tendency of water to cool would be accelerated by the repulsion produced by the heat with which it had been enforcedly and unnaturally associated, since opposite qualities such as hot and cold violently repelled each other when brought into proximity. (Since indeed the rate of cooling in water is at any moment directly proportional to the amount by which its temperature exceeds that of its surroundings and the process becomes increasingly "slow," this

Aristotelian thesis might claim to be "confirmed" by general observation.) Now it is quite irrelevant to urge that the plausibility of these two typical experiments rests merely on the facts that, in the one instance the thermometer had not been invented, in the other that the quantities of water left in each vessel, at the conclusion of the experiment were never measured. They represent a completely different orientation of the attention to the one which we are accustomed to regard as normal in scientific practice. The complete lack of interest in quantitative considerations is a product of a philosophical outlook not of technical difficulties. There is every reason to suppose that such experimenters would have regarded the behaviour of mercury in a tube as by far the less preferable and reliable guide to reality and the truth of things than direct perception, and would have defended the position that the quantity of water is irrelevant to the study of the rate and manner in which water cools in accordance with its own nature.

On such methods a fairly comprehensive, self sufficient schematization of the world was drawn (84), which, if "the recording augmentation, and rational correlation of those elements of our experience which are actually or potentially common to all normal people"(85) be allowed as an adequate definition of Science, cannot be denied that name, though its qualitative foundations prevent it being called so in the sense of being "a particular scheme of correlation of experience, which is not intrinsically limited with respect to the kind or amount of experience with which it may deal,"(86) but which is distinguished by the character of the single type of simple, rational, but not necessarily imaginable, universally applicable, correlation it aims to establish. Such a scheme mathematics offers, and Aristotelianism persistently trying to preserve the qualitative richness of perception and to defend its "reality," was driven into realms quite as abstract but far less accessible to reason. Thus "the forms of qualities and the matter of natural bodies" admits Alfarabi, "are not sensible, we are certain of their existence only by syllogism and apodeictic demonstration."(87) Tymme, an alchemist friend of Dee's writes of Form, Substance and Quality "I doe not thinke that anything can be defined concerning these which is either certaine, constant, or approved by generall consent, so long as man's minde is shut up in the prison of his body, neither can he know by his sense what Matter and Form is."(88) An analysis of the world into such terms as these had little practical utility; its connection with "natural magic" will appear later, but generally it was of little help in providing a method for the further investigation, or imitation or control of nature.(89) It was based on a purely contemplative survey of "experience," and it satisfied by its arrangement of the elements it discriminated therein the needs of the intellect to discover order and coherency there. The defects of its method of doing so, Roger Cotes points out in his Preface to the second edition of Newton's Principia: those who follow it "have attributed to the several species of things specific and occult qualities, on which in a manner unknown they make the operations of the several bodies to depend. The sum of the doctrine of the schools derived from Aristotle and the Peripatetics is herein contained....And being entirely employed in giving names to things, and not in searching into things themselves, we may say, that they have invented a philosophical way of speaking, but not that they have made known to us a true philosophy." Such occult qualities remarked Newton at the close of the Optics "put a stop to the improvement of natural Philosophy," since "to tell us that every Species of Things is endowed with an occult specifick Quality by which it acts and produces manifest Effects, is to tell us nothing."(90)

The chief method of investigating these formal causes was held to be the determination of the end, the perfection, to which they tended, their appearance or expression in matter at any moment could then be interpreted as a stage in a predictable course of development. But such ends were particular to each species. Hence while later science has almost consistently rejected a division of nature into a multitude of small "Wholes" in favour of the fewest possible number, however "unimaginable," of large ones (thus reducing the number of unanalysable, and therefore perhaps unintelligible elements employed, unanalysable because it is in terms of them that everything else is to be explained), their sphere of validity extending as they become progressively more abstract, Aristotelianism, following the normal manner of operating evidenced by "common sense," did the reverse. The usual assumption of Platonism was, as Cusa expressed it, that all things were ultimately related, in a manner which, however directly inconceivable to the mind or senses, made them into a genuine structural unity, sprung from the all containing unity of God.(91) Some of the applications of such a doctrine, as will later appear, may seem fantastic or perverse, but it played a part in the evolution of ideas of universal law, and leads on to the attitude Newton expresses, in the continuation of the passage just quoted "to derive two or three general Principles of Motion from Phaenomena, and afterwards to tell us how the Properties and Actions of all corporeal things follow from those manifest Principles, would be a very great step in Philosophy, though the Causes of those Principles were not yet discovered." In the Aristotelian

scheme there is excessive and crippling heterogeneity. For instance, despite continuous attack from platonist critics — Grescas is a good example here — the dogma of the complete discontinuity, in type and principles of motions, maintaining in the sub- and supra-lunar regions, as well as in the constitution of the bodies occurring in each of these, was not seriously weakened until the Renaissance. Again special Arts and sciences were governed by separate unconvertible methods, and the validity of their principles restricted to particular ranges of subject matter. Cardan quotes as authoritative Aristotle's declaration in the Posterior Analytics that "it is not possible to demonstrate from any genus to another superior one, as from Arithmetic to Geometry: and Averroes states in his great commentary explaining these words: Demonstration cannot be transferred from one Art to another." Thus although, Cardan argues, there must be three worlds, corporeal, incorporeal, and that of living beings, they are utterly discrete, "there is no proportion among them, nor can they be defined by number."(92) Such "universal" laws as might be admitted had no necessary relation with those governing particulars. An interesting example is the treatment of the rise of water — against its own nature — into a vacuum, as treated by Joannes Canonicus in his Quaestiones on Aristotle's Physics (93). It is not considered there as representing the resolution of a previous conflicting interaction of forces or "laws," but is explained in effect, as the temporary complete abrogation of the law governing the particular nature of water causing it to tend downwards, in a situation that has called into operation the universal therefore more privileged "law" which does not permit a vacuum to exist in the world.

One consequence of this, directly related to Aristotle's rigid distinction between the three branches of speculative philosophy, i.e., Theology, Mathematics and Physics, was markedly alien to a widespread intellectual outlook in the Renaissance. This was the comparatively low level of value ascribed to human reason insofar as it might profess to aim at the discovery of ultimate truth, and the very restricted province, that on this evaluation might, logically, only be allowed to it. Even Aquinas, who strongly attacked the Averroist doctrine of a "double truth (94), seems in this respect to assert only the compatibility of reason and faith, and to allow philosophical reasoning merely a negative role — that of purging away errors — while philosophy for Platonic thinkers, such as Pico, "c'est la foi elle meme presentee sous l'aspect rationnel."(95) But the doctrine of the "double truth" was a logical if extreme consequence of the heterogeneity admitted into the Aristotelian picture of the world. It was thrown into greater prominence when Aristotelianism was brought into close conjunction with Christian orthodoxy, more especially as scholars, still maintaining Aristotle's authority, gradually stripped away the superimposed, modifying neo-Platonic features, which had considerably assisted the original reconciliation. Nevertheless, though there can be little doubt that a "Christian Averroism" is chiefly responsible, and provided perhaps the only possible framework, for the growth in the Middle Ages of an autonomous and thoroughly empirical physic, as, for instance, at Padua, yet such an attitude as Siger's, who "lorsqu'il expose quelques-unes de ses theses les plus hardies et en contradiction manifeste avec l'enseignement chretien, il declare ne pas determiner ses solutions selon la verite, mais bien suivant l'intention d'Aristote, et il laisse clairement entendre que ses conclusions sont celles de la raison naturell," (96) wherever it was held sincerely, as it would widely seem to have been, did not offer encouragement, or much inducement to the study of the natural sciences insofar as they were not of immediate and apparent utility. Moreover, whether sincerely professed or not — and for example one may perhaps legitimately suspect irony in Pomponazzi's submission of his reason to the higher otherwise incredible truths of revelation, or that Francis Bacon, recommending a similar denial and violation of reason in religious matters, is merely resolving with conscious sophistry a question for which he feels no great concern (97), wherever it appears, such an attitude nearly always implies a neglect or denigration of such purely intellectual disciplines as mathematics, since on the one hand they do not make direct reference to naturally existing things, and for Aristotelianism even where they are apparently applicable in that field, they are of uncertain validity, and on the other hand being merely rational they are a priori denied any part in revealing that form of "truth" which concerns man as a spiritual being. The rehabilitation of mathematics was one of the consequences of a reviving Platonism that resolved this dilemma by offering a system in which such doctrines as the eternity of the world, and the soul's existence only as the "form" of the body, did not figure as inescapable and necessary conclusions of the reason, which on other grounds had to be adjudged false. From the unity of the world followed the essential unity of Nature, Reason and Faith. Final truth could be reached in any of these spheres, for to attain it represented a need and its discovery a natural activity of man and in Berkeley's expression of fundamentally the same position as this of Renaissance Platonism, "we should believe that God has dealt more bountifully with the sons of man, than to give them a strong desire for that knowledge, which he had placed quite out of their reach....Providence..., whatever appetites it may have implanted in the creatures, doth usually

furnish 'em with such means as, if rightly made use of, will not fail to satisfie them."(98) Reason could be trusted to the uttermost (its detailed relations with Nature and Faith will be discussed later), and the most abstract conclusions that could be established in mathematics could be regarded as being, potentially, of the gravest import.

V. It was largely in questions relating to mathematics, its general status, the validity of its methods, its sphere of application, that much of the new science of the Renaissance found itself in overt opposition to Aristotelianism. Aristotle's own chief interests were not mathematical, and his principal commentator, who had tried most faithfully to reconstruct the original teachings of Aristotle, Averroes, was no more a mathematician than his master, and, as distinguished from almost every other leading Arab thinker, left no separate work on number. Mathematics Aristotle seems to have regarded as merely a particular rational scheme of fictions or abstractions, that might or might not apply to certain parts of reality. "Mathematical accuracy," he had declared, "is not to be demanded in everything but only in things which do not contain matter. Hence this method is not that of natural science, because presumably all nature is concerned with matter,"(99) and held it a defect and limitation of harmony and optics that they did not study their objects "qua sight or qua sound but qua lines and numbers" with the aid of mathematics (100); and Italian Averroist scientists of the sixteenth century, it has been shown, still maintained a sharp distinction between the "analytic" method proper to mathematics and the "resolutive" one of natural science, which alone led to discovery and started always from the evidence of the senses (101). In striking contrast is the declaration of Dee's associate, Pedro Nunex, that he intends to abandon the orthodox procedure in the natural sciences, and employ a method of demonstration modelled on Euclid (102).

In many particular points the new science found itself in direct opposition to Aristotelian doctrines. Astronomers, whether or not they believed in the physical truth of Copernicanism, widely admitted that Aristotle's transformation of the geometrical hypotheses of Eudoxus into an intuitively conceivable mechanism, had been unjustified and was not, anyway, in its original form, to be accepted. Aristotle's determination of the speeds of the planets, as being proportionate to their distance from the zodiac, those farthest from perfection requiring the most — the swiftest — motions (103), was, it was frequently pointed out — as by Dee's acquaintance Jean de Peno, in his preface to his edition of Euclid's Optics in 1556 — an exact reversal of the facts, was the mistake of one ignorant or neglectful of mathematical sciences. Cardan as a "naturalist" Aristotelian still examines change and motion in terms of tendency (Appetitus) (104) and prefaces a description of machines, by a discussion of the distinction between natural and violent motions (105), but the disadvantages, and even contradictions, inherent in such an attitude become progressively more apparent, in numerous particular sciences, as for instance in ballistical questions (106). A good example of the conflict between Aristotelian doctrines, and direct scientific findings of a kind which were increasingly regarded as important, and the fundamental difference in their respective attitudes to quantitative considerations is Hakewill's criticism of the statement of Aristotle that the elements "as they rise one above another in situation so they exceed one another proportione decupla, by a tennefold proportion," which Hakewill denounces as nonsense since water is nowhere more than two to three miles in depth, but the diameter of the earth is seven thousand miles, while Nonius and Vitellio have shown the air to be only fifty-two miles deep. In a later part of his book Hakewill prints a reply he has received from an Aristotelian Bishop (G.G.) on this point. It states: "I have often desired you in theories not to bee exact in proportions, as if man's imagination could apply a compasse and rule to measure out speculations; these Mathematical punctilioes are not to be admitted in Philosophy, yet it is necessary that in things which are most uncertaine, wee should guesse at some certainty and be guided by one Rule, and herein Aristotle hath done what the wit or endeavours of man could effect." None the less G.G. goes on to cite numerous "experiments" which will support the accuracy of the tenfold proportion of the elements, all of which Hakewill patiently explores and reveals their fallacies or unreality (107).

But besides the multitude of particular questions in dispute a more general one regarding knowledge and logical method was involved. Thomist Aristotelianism had effected a compromise with Anselm's position by admitting Anselm's definition of truth as referring to the adequation of the thing to the divine understanding though not to the human (108): its implications in regard to human understanding were clarified by Peter d'Ailly who then distinguished absolute knowledge, which is reducible to first principles but remains purely formal, and all intellectual knowledge of things, which must be derived from the sensations, and can, in consequence, never be more than probable. On the other hand, the geometry of Euclid or the statics of Archimedes seemed to present the sixteenth century with systems at once a priori and synthetic, and of complete certainty. Compared to these, formal syllogistic logic seemed a cumbersome unprofitable instrument, a possible if almost sterile method of organising what was already known, but which did not reflect the natural processes of thought or assist psychologically to discovery or creation. It was of course a pattern, though a very artificial one, to which all correct thought might eventually be

reduced, even geometry (where the logical procedure, constantly suppressing the major premiss, is in effect enthymematical) though the resultant expression would be so lengthy and involved that it would obscure rather than illumine. There was indeed an attempt in the sixteenth century to set out Euclid as a series of syllogisms (109), but a multitude of others — some will be mentioned later — which attempted the reverse, and expressed various bodies of knowledge — even medicine — in Euclidean fashion. It was his lack of employment of such methods, and his attitude towards them (as well as his defence of such dogmas as the eternity of the world), that caused Campanella's Solarians to refuse, typically, the name of philosopher to Aristotle and to regard him as a mere logician.

VI. It is fairly easy to detect the immediate individual sources of much of Dee's thought — he draws extensively, for example, from Proclus, Cusa and Roger Bacon. Its location within a Platonic tradition can also be negatively delimited to some extent — he acknowledges no debt to Ficino, and references to purely "humanist" or "moral" philosophers are rare; Pico, despite his considerable reputation in England, served rather as a prophet than a guide, for though he constantly proclaims the power and importance of "magic," he laid down no clear methods that could be of direct assistance for the investigation or control of nature; indeed his general views on questions of natural science seem deeply influenced by his Averroist training and are of a relatively reactionary cast. An exposition, however, of the general metaphysical scheme and principles, which underlay or came to be associated with much of the new science, must be largely arbitrary in form, and, compared to the historical manifestation of this thought in the Renaissance, will be over explicit, and the divisions and distinctions it sets up artificial. For though the change introduced into science was simple and profound, the movement of thought that led to it was extremely complex and varied, and thoroughly eclectic. It grew up in close contact with the older thought and made use of it as far as possible. It did not in general directly oppose Aristotle, or denounce him as one who had "defaced the monument of the ancient metaphysical theology by his profane hands," (110) rather with some modifications and a general revaluation it incorporated much of his teachings into its own general synthesis. The Thomist reform had preserved a place for Plato in admitting his value as regards things spiritual, while making Aristotle an undisputed authority in the realm of natural things. The new thought, taking Platonic doctrine to have universal reference, allowed to Aristotle's work the status of a preliminary discipline, and accepted Aristotelianism as an heuristic provisional guide in a number of studies — notably medicine, in which the former could not widely or obviously be yet applied.

This reconciliation and incorporation had perhaps always been one of the characteristics of neoplatonism. The polemic of Atticus against Aristotle does not seem to have represented a very widespread or historically influential attitude. The fifth century academy under Syrianus explicitly labelled Aristotle's works as a propaedeutic to the study of Plato. Thus Marinus declares that Proclus studied Aristotle under Olympiodorus in Alexandria until he "felt that they [peripatetics] were no longer interpreting the text they were explaining in a spirit worthy of the philosopher" (Aristotle), and migrated to the Platonic Academy at Athens. For two years "Syrienus read with him all the writings of Aristotle in logic, ethics, politics, physics and even theology....as if they were preparatory rites or lesser mysteries," and afterwards "led him spontaneously....up to the greater mysteries of Plato, and revealed their truly divine visions to the untainted eyes of his soul and the pure gaze of his mind.(111) Ammonias Saccas had attempted to demonstrate the concordance of the two, and the Enneads of his disciple have been presented as representing a wedding of an Aristotelian metaphysic to a Platonist psychology (112) (to the mere "thinking" that Aristotle had allowed to the prime mover for example, he added the attributes of "will" and "love," and it is the god of Plotinus rather than of Aristotle that Aquinas later reproduced). The Aristotle of the middle ages — and it was still the Aristotle that Renaissance Platonism largely adopted — was a product of this conciliation. Boethius had presented them with a "platonised" Aristotle, and many of the works passing under Aristotle's name were compilations from purely Platonic sources. Thus the Theology, supposedly supplementing the Metaphysics, is taken from the last three books of Enneads, his "last work," the Liber de Pomo, translated into Latin at the command of Manfred of Sicily is a paraphrase or imitation of the Phaedo; the Liber de Causis is a translation from an Arabic work based on Proclus' Elements. It is from these works that, for example, the greater part of Roger Bacon's quotations from "Aristotle" are drawn, and they do much to explain how he reconciled his particular metaphysic with his explicit assertion that Aristotle was the greatest, and far greater than Plato, of all ancient philosophers. Such writings were rejected by Renaissance Aristotelians, attempting to rediscover and defend the historical Aristotle, on the ground of their spuriousness, but they continued to be accepted, if not as genuine, yet as valuable writings by many neoplatonists of the time, on the ground of their content.

That scientific Platonism meant rather an infusion of new ideas with the mass of materials offered by older thought, and not a rejection of it, was an inevitable consequence of the resources available. A reflection on this is that although Dee consciously tried to apply what he believed was a Platonic-Pythagorean approach to his personal investigations, yet his library list reveals that while he possessed some hundreds of commentaries and studies on the writings of Aristotle, there were but a handful, Chalcidius, Proclus, Pletho, etc. directly or solely concerned with the Platonic dialogues, and a similar proportion maintains between works dealing with Averroes and Avicenna. Plato himself was an inspiration rather than authority, no essential distinction was made between him and later followers. But this of course was merely the traditional view. Augustine always

defers to the interpretations of Plotinus, since he regards him as the philosopher who most thoroughly understood and reproduced the thought of Plato (113), and he suggests that from their works they might naturally be mistaken for contemporaries. The very names of these two were confused in their Arabic transliteration, and the fusion passed without remark. Thomas Taylor, in many ways closer to Renaissance scholarship than that of his own day, continued the habit of interpreting Plato "absolutely" and unhistorically through Proclus, Plotinus and Porphyry, into the early nineteenth century (114). They were all indeed regarded as faithfully preserving a single, unified body of doctrine, as representing a tradition of which even Plato was not the originator, but which contained also the Chaldean Oracles, Hermes Trismegistus, Moses and Adam. Proclus according to his biographer Marinus, had said that he wished all books in the world could be burnt with the exception of the Timaeus and Chaldean Oracles (115), and it was the Timaeus — which had been the only specimen of Plato's original work available through much of the Middle Ages, that, perhaps along with the Epinomis, continued to be accepted by many scholars of the Renaissance as the principle treasure house of Platonic doctrines. Related to this attitude is the fact that many of the "Platonic" doctrines which were now most emphasized and turned to most account do not figure to any great extent in the dialogues, but are exposed fully and attributed explicitly to Plato in Aristotle's various criticisms of his thought. They concern primarily the nature of numbers and the function of mathematics (116a). Aristotle's interpretation of these views was frequently accepted in many details (important in this respect is his denial of any real difference between the natural science of the Platonists and Atomists, since both were ultimately trying to reduce all things to quantitative relationships (117a)). This accounts to some degree for the Pythagorean bias in later interpretation of Plato, which very often resulted in these two being regarded as practically equivalent. Both Platonists and Pythagoreans believed numbers to be the principle of things, Aristotle asserted (118a), and he maintained that there was no more than a verbal difference between the Pythagorean "Things imitate number" and the Platonic "Things participate number."(119a) Porphyry records that in his day the general charge was made against Plato of "stealing" Pythagorean doctrines; Aulus Gellius went so far as to give the fantastic prices supposedly paid by Plato for the works of Philolaus and had quoted Timon's poem accusing him of compiling the Timaeus from Pythagorean books (116b); thus in 1584 the learned Ranzovius refers to "Pythagorus, Italicae Philosophiae princepts, quem Plato pene in omnibus imitatur....(117b)

VII. Yet despite the sometimes confusing variety of forms assumed by Neoplatonism, its continual mingling with a rich diversity of extraneous teachings falsifying in advance any very precise general delineation, there were a number of respects in which it constantly remained faithful to its original source; more especially in its placing of primary importance on the "two things in which" it has been said, "Plato is more interested than in the theory of ideas itself, for that theory is after all only his way of satisfying these two requirements; first that there is such a things as mind which can apprehend reality, and second, that this reality which is the object of knowledge has absolute and unqualified existence."(118b) Thus the epistemological analysis offered by the Theaetetus, with its apparently negative conclusions, is an illustration of the thesis that it is impossible to extract knowledge from sensible appearance if the world of true being is left out of account. This world is known through the mind, it is the real reference of thought, for, it is argued in the Parmenides (119b), a thought cannot refer to nothing, to what "is not"; the Forms cannot be mere thoughts, for a thought is always an act which has something other than itself as an object, and the thinking of Forms, which cannot be sensible perceptions, must therefore be of "Real Forms." Every mental operation therefore appears as the intuition of an object. The mind's direct insight into reality is sometimes exemplified in the dialogues by the way in which genuine new knowledge can arise from reflection, can be born from the rearranging of words, the referential content of each one of which taken singly was nevertheless apparently fully known previously (for the Cratylus freely admits that, whether single words can be held to "resemble" things or no, they can only be significant for those who already know the things they represent (120)). Since mind thus communicates with a higher more extensive aspect of reality than the sense, "opinion and reflection and thought, and art, and law, will be prior to things hard and soft and heavy and light; and further the works and actions that are great and primary will be those of art; while those that are natural and nature itself, which they [the scientists] wrongly call by this name, will be secondary and will derive their origin from art and reason."(121) Such a view of the character of mind, explains why, in the last resort as well as for preliminary investigations, "Aucune demonstration logique, aucune serie de deductions n'est superieure, pour Platon, a la simple analyse psychologique de nos facultes intellectuelles"(122); it accounts for the consciousness Platonism frequently displayed of being — as Nietzsche said much philosophy had always been — "a recognising, a remembering, a return, and a homecoming to a far-off ancient common household...a kind of atavism of the highest order"(123): for in the logical working out of this view of mind it was usually found to be necessary to have recourse to some theory of anamnesis, or of individual minds' participation in, or illumination by, some unified intellect transcending them.

There was complete agreement between the two schools that knowledge dealt with universals and not particulars, and that logic — and perhaps also mathematics — was a necessary preliminary discipline to other sciences. For instance, though Bruno makes it subserve a special purpose, there is nothing in the statement itself, which he employs fundamentally in his exposition of the Lullian Art — "Subiectum considerationis est universum, quod veri intelligibilis rationabilisque rationem subire valet,"(124) that would distinguish it as either Aristotelian or Platonic; nor is there much to which either party would not subscribe in Hugh of St. Victor's insistence that logic and mathematics which "treat of the intellectual comprehensions of things" must be prior, in order of learning, to physical speculation since they "put their consideration not in the actual state of things where experience (experimentum) is deceitful, but in reason alone, where unshaken truth dwells. Then with reason provided for they could descend to the experience of things."(125) But there is sharp contrast between their respective evaluations of these sciences as direct contributions to positive knowledge, and between the relationship allowed between the universal and reality, as to whether it or the particulars falling under it represented an approximation to the other. For Pico for instance "La connaissance a pur but non pas la connaissance des choses concretes mais celle de leur immuable modele. Le critere de la verite de cette connaissance est sa concordance avec l'idee"; "si ut exemplari suo quam vocamus ideam secundum quam illas condidit deus....respondent, verae dicuntur...." and the formulation of a concept was "le comprehension de la substance divine qui se devoile dans les choses."(126)

There was perforce, Cusa frequently insisted unanimous agreement that the beginnings of all intellectual knowledge was "faith," something which forming the ground of discursive knowledge could not be proved by it but only taken on trust; since in all spheres it was necessary to pose certain premisses of this order from which the intellect drew the matter of which it treated and its method of doing so; and on which ultimately all intelligibility depended (127). Truth thus appears as a function of a logical system, and the description of a proposition as true can mean only, and exactly, that it has been implied by a previous proposition in a manner admitted as valid,

and also that this proposition, or the first term of the series of propositions standing in such a relationship to each other has been taken for granted, accepted as an axiom of the system. Now it is clear that two kinds of suppositions are made here: firstly concerning valid formal logical procedures, secondly, if the system is to have any experiential reference, and a chain of deductions is ever to conclude in a synthetic statement, then at least one proposition must be initially postulated, having synthetic content (that something is thus or thus), and which is susceptible only of empirical verification, and only thus saved from being merely conditional. These two Aristotelianisms separated as Platonism did not. The various principles of logic, it held, admitted not of absolute proof but only of one "ad hominem" (128) they were accepted perhaps as "natural facts," but not treated as "hypotheses" — as statements in a metaphysic proceeding from higher principles on which they could be satisfactorily believed to depend whether or not the nature of these was directly accessible to human reason; while "verification" was ultimately to be sought in the data provided by the sense concerning objects totally independent of mind. The limits of logical thought were to correct to some extent errors in the data — discrepancies between various appearances of the same object — and to reveal reality already entirely present in these objects, though perhaps not fully manifest at any one time since they were all undergoing processes of generation and corruption — its function was merely to explain the sensible world by a rational organisation of it in terms, as far as possible, of selected privileged aspects of perception. In contrast, Platonism did not restrict experience — in so far as this term refers to the source of genuine synthetic knowledge — to the senses; the necessary preliminary synthetic propositions could be found in the mind itself and the direct experiential verification of them was, if not yet fully, an ability of the soul; indeed abstract thought, imagination and sense, were all fragments of one final experience, represented under various guises, of the unity of things, which, since it was an experience which included all knowledge in itself, necessarily implied the otherwise "hypothetical," principles of logic. Indeed the hierarchies of existence, reason and value were considered as only complementary aspects of the same reality, inseparable and mutually implicative; there is an insistence on what has been called "the fact that the ontological predicates are meanings that depend for their meaning on the acknowledgment of values,"(129) and that the intellect is orientated towards values; while these values are, understandably, accepted in such neo-Platonic systems as actual and transcendent since such Renaissance systems do not of course consider, and therefore make no allowance for, the only other possible alternative, that it is the orientation of the intellect (in man) which itself defines, and by giving a form to, in effect gradually creates, values.

The final and unique belief for Plato, which would supply the equivalent of a direct inspectional verification of fact by a genuine intuition of reality, and also a guarantee of formal correctness of logical method, was the Idea of the Good, which was at once the goal of life, the condition of knowledge and the sustaining cause of the World. For Christian Platonists such as Clement the Idea of the Good becomes fused with the nature of God as known by scriptural revelation and by the "illumination" of all individual minds, proceeding mediatedly from God, but which is only thoroughly certified by the acceptance of some revelation. But when Clement insists (120) on the dependence of all knowledge, indeed of the very possibility of knowledge, on such revelation, that there can be no third term between a self communication of the divine and absolute scepticism, he is not advancing such revelation as exhausting the form or content of all accessible knowledge, but claiming it merely as a premise which having absolute certainty, and universal application, guarantees retrospectively the validity of all human knowledge which can be exhibited in a unified coherency; and this by the mere fact that its own existence certifies that there is knowledge and that it may be possessed by the mind, hence any proposition that can be shown to belong integrally to such an ordered system in any connection may then be taken as wholly compatible with, and certified by, revelation.

Where recourse was not made to such revelation, the possible, though rare, attainment of contact with the One, or Idea of the Good, by the individual mind was employed, to demonstrate the existence of ultimate grounds of certainty for thought, resulting in the emphasis on what has been called "interiority" of the Neoplatonism of Plotinus and thereafter of the majority of thinkers in this tradition, which provides a sharp contrast to classical thought in general. Since the idea of the Good was much richer in content than single experiences, was not an intellectual abstraction from them, but all-comprehensive, and involved the complete reconciliation and co-existence of apparent contraries, it thus transcended all intellectual knowledge employing division and discrimination, and rejected all descriptions that any form of discursive thought might attempt to impose on it. The contemplation of it could take place in a mystic trancelike state which Plotinus, employing the paths suggested in the Symposium, frequently achieved, according to Porphyry,

who also claims to have once, at the age of sixty-eight, similarly approached near, and been united with, the supreme divinity; while Procus, says Marinus, by his mental purifications attained at last to and "by his own eyes he saw those truly blessed visions of Reality, no longer obtaining this knowledge by reasoning or demonstration, but as if by vision, and by simple and immediate perception of the intuitive faculty — viewing the ideal form in the Divine Mind."(131)

Nevertheless the process was thoroughly intellectual (as opposed to something won through moral discipline or the exploitation of emotional feelings). "I believe we are not permitted to think that God dwells in any other part of us than the intellect," wrote Synesius, whose work on divination, and some confusion with the homonymous alchemist contributed to his high reputation in the Renaissance (132). The passage to the One for Plotinus could only be effected when noumena were fully realised as arising from the world of the sense. The attainment of the One was, following Plato's analogy of the line, represented as the final term of a progressive intellectual ascent. The hierarchy in which science and modes of knowing could be arranged, could thus, even in the absence of direct experience of the One, or Idea of the Good, by the observed direction of its development define as it were, the position of this, and the sciences in their successive higher generalities, could indicate something of the nature of that on which they were all ultimately dependent. Such a connected hierarchy of knowledge leading upwards to a source which alone verifies its content is described by Proclus, in the commentary on the Euclid: "l'ascension des connaissances va des choses plus particulaieres aux plus generale jusqu'au moment ou l'on s'eleve a la science meme de l'etre en tant qu'etre....cette science est la plus collective de toutes et...toutes se ressentent des principes qui viennent d'elle; car celles ci suggerent toujours les premieres hypotheses au dessus de celles qui leur sont subordonnees, tandis que celle-la fournit d'elle-meme, et comme etant la plus parfaite des sciences, des principes a toutes, universels pour les unes et plus particuliers pour les autres."(133) The confirmation of all certitude however remained necessarily dependent upon some direct experience to be found at the upper termination of such a scale, this final experience, which involves all knowledge, and is its actual source and logical foundation, Augustine identified with the "beatific vision."(134) It became a familiar analogy to compare the Reason's elation to God with that of the eye of the sun — it was a power that remained helpless until things were illuminated for it by God (135). In the seventeenth century Henry More still employs similar ideas when he speaks of "a certain principle more noble and inward than reason itself, and without which reason will falter or at least reach but to mean and frivolous things," and which is of so "retruse a nature" that he hesitates to name it, but finally calls it "Divine Sagacity"; it is "a more inward compendious and comprehensive presentation of truth, even antecedaneous" to reason, though the activities of reason serve to confirm and illustrate it (136). Similarly John Smith founds truth and knowledge on "an intellectual touch of Him," and distinguishes, following Proclus, ascending degrees of knowledge beginning and ending in "intuition," from a "naked perception" through a miscellaneous collation of impressions, Discourse, Reason, Mathematics and Dialectic, to a "naked intuition of eternal truth," the realisation of the last being not wholly possible in life, for "imaginative Powers, which are constantly attending the highest acts of our soul, will be breathing a gross dew upon the pure glass of our understandings."(137)

The doctrine of a scale of degrees of knowledge, the higher whatever the immediate efficient causal occasion for their appearance in the individual mind, being functionally independent of the lower and successively approximating more closely to Reality and True Being, is a marked feature of neoplatonism. It appears occasionally with an admixture of Aristotelian doctrine in Boethius (138), but in the work of Avicenna, who was according to Roger Bacon the vehicle for the last of the four great revelations made to mankind by God, and to whose "Theology" Dee notes his adherence, it achieved formalised, explicit and influential expression for the middle ages and Renaissance. Rejecting the original Platonic Ideas — though only in the guise under which Aristotle had critically exposed them as useless or self-contradictory — he distinguishes four degrees of "abstraction": that supplied through the senses in the presence of the material object, secondly imagination which continues to envisage the object in its absence through its sensible attributes, thirdly the "vis estimativa," which allows of particular judgments which discover certain immaterial ideas in the object, through which alone the mind becomes aware of them — the lamb's recognition of "enmity" in the wolf is an example — while although these surpass the apparent content of the data supplied by any one of the senses, they are still rather considered as possessed of presentational immediacy, as essentially connected with the character of the object in the nature of things than as imported into sensation by the mind as a product of educated association; and lastly, accessible only to rational beings such as Man, the Universal. The materials for the first three operations are all furnished by the "intelligence" and represent the extent of its unaided

capacity for taking account of the external world it perceives through the senses; but in knowing the universal, the intellect becomes "actual" in a way not determined, by particular objects, while since what exists potentially only becomes "active" by the assistance of something already "active" of the same nature as itself, a separated Intelligence is postulated by Avicenna, which governs the sublunar world, gives forms to all things, and transmits "intelligible forms" to the human intellect, which then becomes "active" in applying them to the three lower types of knowledge already in its possession. As regards these "universals" or "intelligible forms," Avicenna asserts even God's knowledge is of the same order as man's, and thought comprehending everything past and future at once, yet still requires a "discursus," though of a non-temporal kind (139). In the Latin West the activity of the separated intelligence was usually interpreted, as for example in Gundissalinus' de Anima which closely followed and "Christianised" Avicenna's arguments, as the Augustinian illumination of the mind by God; Avicenna himself being accepted as having formalized a philosophy implicit in the theological writings of Augustine: "Il parut d'abord offrir une sorte de developpement de Saint Augustin, et les rapports que l'on pouvait etablir de l'un a l'autre furent la raison de l'influence profonde excercee par Avicenne dans l'Ecole Franciscaine."(140)

The view of the nature and powers of the mind here presented is a general and distinguishing feature of neoplatonism. Thus Anselm's ontological "proof" of God's existence, which Albertus Magnus significantly stigmatised as "a Pythagorean sophism," it has been observed, "was an expression of his conviction that thought penetrates significantly to the ultimate nature of things."(141) The understanding, said Cusa, is always directed towards being, it is nourished on truths which recall it to the Divine Wisdom, from which its activities derive, and of which, since it tends towards it, it has already some slight "foretaste" or precognition (142). Cassirer drawing attention to Galileo's frequent use of the Meno, particularly the incident of the slave's solving without instruction a problem in geometry by "natural" reason, stimulated by questioning, remarks, "Galileo seems to accept all the consequences drawn by Plato from this fact. He declares that truth being necessary and eternal cannot be attained and cannot be proved by experience alone. Experience gives us accidental facts, but it cannot teach us any necessary truth. The necessary things, that is to say those for which it is impossible to be otherwise, the human mind either knows by itself (da per se) or it is impossible for it sever to learn them"(143) (an example which illustrates the connection of this stream of thought with the new science — Descartes similarly was to locate the Archimedean point of the philosopher within the mind)(144). Again Cudworth, in the same tradition, holds that universals cannot be derived from things, but "things" are perceived via universals: these exist already, and completely, within the mind, and seem to stimulate it into activity. "The essence of nothing is reached into not by the senses looking outwards but by the mind's looking inwards into itself." The "primary and immediate objects of intellection and knowledge are not things existing without the mind but the ideas of the mind itself actively exerted"; that is the mind itself must supply the intelligible "reason of things" and judges of truth and being, by the degree to which its innate standards of coherence are satisfied, for "the entity of all theoretical truth is nothing else but clear intelligibility; and what is clearly conceived is an entity and a truth,"(145) for even omnipotence could not create a mind capable of forming a clearly intelligible idea of a falsehood.

Before noting some of the effects of such doctrines on views as to general structure of the world, the use and status of mathematics and their relations with the scientific outlook of the Renaissance, something must be said of the considerable transformations the Theory of Ideas underwent, retaining something of the vocabulary but little of the probably meaning of the original Platonic statement. In some respects a belief in separated forms was more congruous with Christian teachings than the Aristotelian position that they were only definitions embodied in matter, while it did not pass unnoticed from the earliest times that Aristotle himself had not been able universally to apply this postulate, since although he denied the existence of form apart from matter, the Prime Mover, on which the whole dynamics of his cosmology depended, was itself nothing but Pure Form. Boethius who, as an accepted source and authority, transmitted to the Middle Ages a presentation of classical philosophy, in which elements from Plato, Aristotle, the Stoics, later Platonists and perhaps Augustine, were inextricably commingled, exhibits confusion and offers apparently contradictory statements on this point. He denied for instance on the one hand that the world is framed by God after any models (146) and in another place addresses God, "thou dost all creatures' forms from highest patterns take."(147) In one treatise he can state "essences indeed can have a general existence in universals but they have particular existence in particulars alone, for it is from particulars that all our comprehensions of universals is taken,"(148) yet in De Trinitate, after setting out an Aristotelian analysis of essence depending on an only abstractedly separable form, and the three grades of speculative sciences Physics, Mathematics and

Theology distinguished in accordance with this, he adds that matter is "subjected to" universals, and that "we misname the entities that reside in Bodies, when we call them forms; they are mere images; they only resemble those forms which are not incorporate in matter."(149) Indeed even after the time of Aquinas, except among Averroists, until the late Renaissance it would seem to have been usual, for professed followers of Aristotle, while accepting Aristotelian doctrines as undoubtedly true as far as human knowledge was concerned, nevertheless to admit, that as regards God, essences were possessed of existence independent of, and prior to, particulars. Mandonnet thus writes of Albertus: "Pour lui tout en admettant avec Aristote, qu'il n'y a que des singuliers dans la nature et que l'universel est dans l'intelligence humaine, il ajoute a cette double donnee l'affirmation de l'existence d'un universel anterieur a sa realisation dans les singuliers, et independent du fait de son actualite."(150)

Plato's postulation of the Ideas provided a certain foundation of knowledge, relating it directly with reality, such as could not be derived from the sensible world, and also provided a mediate realm, logically ordered and accessible to mind, between the sensible world and the Idea of the Good. This last was acutely necessary, since the Idea of the Good is nowhere directly discussed in the dialogues and indeed perhaps could not have been by Plato without employing terms, which although readily acceptable to later "platonists" who were able to regard the Parmenides as expressing a mystic theology, would have suggested to the classical Greek mind, had the representation of this formless absolute been then attempted, only the horrors then invariably associated with the undetermined, and unlimited, which were properties pertaining rather to what lay below the level of what was intelligible, denoting deficiency, evil, and primitive unqualified matter (151). Many difficulties regarding the theory Plato directly or by implication did successfully resolve; thus as to apparently contradictory assertions about the immanence or transcendence of Ideas, his general treatment may be taken as showing that, he "eut accepte les deux theses, et selon son expression: pris les deux a la fois: en distinguant les point de vue" (152) and the application of the "Third Man," with its consequence of setting up an infinite regress, would thus not be a valid objection. However, large groups of "Ideas" — those of the mathematicals, or connecting modes or structures of thought are the chief exceptions — lie open to Aristotle's objection of being a useless and unnecessary duplication of the external world. For they themselves seem to be almost concrete entities, differing from the sensibly perceived only in being permanent and stable — and also lie, it would frequently seem to be implied, outside mind — though the mind may have innate memories of them — for they are objects of knowledge for it, to be reached by its activities, they are not mental phenomena belonging to some higher intelligence, in which individual minds participate, but rather "things," endowed with all the qualities that would be at first intuitively ascribed absolutely to sensible objects (qualities the Greeks seem never to have wholly disassociated from their fundamental assumptions about what the nature of Reality must be), but which a later critical analysis — such as the Heraclitean — shows to be indefensible, as a view of merely sensible objects. In the reinterpretation of the theory, which became general from the early centuries of the Christian era onwards, "apprehension of the ideas is not so much a result reached by the activity of intelligence, as the presence in the intellect of, or the illumination of the intellect by, the Ideas."(153)

Thus Alcinous in the first century, conciliating Plato and Aristotle, situates the Ideas in the divine Intelligence, they become as it were from thence forward the thoughts of God, but thoughts which are active, "productive of things," an instrument of creation (154). In such a tradition Augustine stresses that things exist because God knows them; He does not know them because they are, for His thought, as opposed to man's which is merely reflective and representative, is creative and constitutive (155). Similarly the great principle of Avicenna's system is, it has been said, "Penser, chez les substances separees, signifie creer." (156)

A similar change occurs in what the Ideas are considered to be for the individual mind and the type of knowledge which this possesses per se. Porphyry when he joined the school of Plotinus was, after much disputation, led to reject his earlier view — perhaps nearer Plato's own — that the ideas could exist as separate entities outside the mind. But the concepts that are innate in the soul, to Plotinus are no longer "objects" which in their qualitatively perceptible aspects sensible things imitate as closely as possible; they are the noetic activity of the soul, the principles according to which it "energises." It was in some such form as this that the theory of Ideas generally survived and developed, still claiming to be "Platonic," so that in the seventeenth century John Smith, drawing largely on Plotinus, defends "innate ideas" as being in reality a reflection of the structure of the mind, and as representing not discrete particular objects of knowledge, but the functioning of an active nature latent within us, and Henry More regards them as "our own modes

of considering sensible objects": cause and effect, like and unlike, whole and part, for instance, being the "natural furniture of human understanding."(157)

Such a view, although apparently much looser and more vague as to the precise nature of the objects and forms of a priori knowledge than the original Platonic statements, proved in practice highly fertile in suggestiveness. A typical Renaissance popular rather than philosophical expression of it is offered by Eliot's Governour. Discussing "Sapience," he says "that god almyghtie infuded Sapience into the Memorye of man...whiche, as a Treasory, hath power to retayne, and also to erogate and distribute, when opportunitie hapneth....More over Plato (in his boke called Timaeus), affirmeth that there is sette in the soule of man commyng into the worlde certayne spices or as it were sedes of thynges and Rules of Artes or sciences. Wherefore Socrates (in the boke of Science) resembleth hymselfe to a mydwyfe...And like as in houndes is a power or disposition to hunte, in horses and grehoundes an aptitude to renne swifetly, so in the soules of men is ingenerate a lerne of science, whiche with the mixture of a terrestryall substaunce is obfuscate or made darke, but where there is a perfeyte mayster prepared in tyme, then the brightnes of the science appereth polite and clere," for it is to be developed by practice and exercise (158). An example of the type of knowledge which could be regarded as deriving from this source is provided by Galileo's Dialogues of Two principle systems of the World. When Galileo, in the person of Salviai, is accused by Simplicius of erring with Plato, holding that "nostrum scire sit quoddam reminisci," far from rebutting the charge, he proceeds to lead on Simplicius and Sagredo to deduce for themselves, on apparently a priori grounds, certain fundamental propositions of mechanics and the true laws of physics (159). In such a development as this it would seem that the Ideas, in the form in which they are accepted as innate in the mind, become in fact, however unconsciously on the part of those employing such theories, increasingly connected with and solely taken as indicating the particular way in which Mind apprehends Order.

The resultant subtilization, or rather radical change in the nature of the Ideas, is clearly to be seen in the case of mathematical entities. After listing five degrees of knowledge, distinguished by various instruments they employ for representing reality, Plato writes "Every circle that we draw or make in common life is full of characteristics that contradict the fifth thing, the true circle, for it everywhere coincides with a straight line, while the true circle as we said has in it not the slightest element belonging to a contradictory nature."(160) The idea of the circle is here, as it were, a purification of an intuitive datum, existing by itself, and unrelatedly, as a primitive atomic object of thought. On the other hand, Cusa and Bruno introducing for this purpose infinity into mathematics, find it of more importance to investigate, and to reason and draw ontological conclusions from circles that coincide throughout with straight lines, to reach Ideas which, produced by rigorous logical thought and therefore intelligible, embrace and unify under one principle, as many "contradictory natures" as possible. Thus Cusa, rejecting imagination which, confined to sensible things, obscures by false particularisation (161), lists a number of descriptions of the maximum, employing apparently widely differing entities, lines, triangles, and circles, and then states that the originators of all these were, at the same time, of one opinion and possessed of an "exact conception" of the maximum (162), and asserts that the mind can arrive at such concepts, which may be usefully and validly employed, even though it is incapable of fully envisaging them (163). The limitation of what may be said to be "conceived," or be described as "a clear and distinct Idea," to the imaginative faculty led of course to Berkeley's denial of existence to general abstract ideas (e.g., Triangle), and similarly to Mill's remarks on the geometrical line, that "the mind cannot form any such notion, it cannot conceive length, without breadth; it can only in contemplating objects attend to their length exclusively of their other sensible qualities, and so determine what properties may be predicated of them in virtue of their length alone. If this be true, the postulate involved in the geometrical definition of a line is the real existence, not of length without breadth, but merely of length that is, of long objects."(164) These views illuminate by contrast the attitude of much Renaissance neo-Platonism, particularly that influenced by mathematics, diametrically opposed to them in this respect. For already by the Renaissance to Platonists the Idea is frequently thoroughly functional, to "conceive" adequately is becoming translatable by "to be able to operate with," to be clear and distinct is coming to signify a potentiality for being subjected to an intelligible analysis within a system of reasoning, existence is allowed to that of which a logical account can be given. Indeed the standard that is here adopted of what is "objectively" true, together with the recognition of its origin in reason, may without much distortion be compared to Frege's position: "So verstehe ich Objectivitat eine Unabhangigkeit von unserm Empfinden, Anschauen und Vorstellen, von dem Entwerfen innerer Bilder aus den Erinnerungen fruherer Empfindunge, aber nicht eine Unabhangigkect von der Vernunft; denn die Fragen beantworten, was die Dinge unabhangig von der Vernunft sind, hiesse urtheilen, ohne zu

urtheilen....Der grund der Objectivitat kann ja nicht in dem Sinneseindrucke liegen, der als Affection unserer Seele ganz subjectiv ist, sondern soweit ich sehe, nur in der Vernunft" etc.(165) While as respects neo-Platonic systems adopting a similar position, however doubtful its truth as applied to the thought of Plato, the view may to a large degree be maintained that "The Platonic Idea is the expression of the simple thought that every rightly formed concept has its solid basis in objective reality," since "every representation as such as a universal relation, not the individual phenomenon, as its content."(166)

The mind is supposed to attain these concepts by a process of discovery, an increasing self-consciousness, which usually remains fairly close to the original Platonic anamnesis — indeed the acceptance of such a doctrine can be shown to destroy the basis of Aristotle's attack in the Prior Analytics on the Platonic investigation by division, as a false syllogism, perpetually begging the questions, as well as much of his other criticisms and is perhaps the only firm basis for answering it. In this process the sensible world is of assistance in suggesting, and pointing to, the general truths from which it derives being. Thus in Plato's words "we see through not with the sense."(167) Thus "the geometrician and arithmetician," writes Plotinus, "knowing in the sensible object the imitation of that which subsists in intellection, they are as it were agitated and brought to the recollection of reality."(168) Some such stimulation may be necessary, but it provokes rather than controls the essentially active process of recollection: "Memory is not a certain repository of impressions, but a power of the soul exciting itself in such a way as to possess that which it had not."(169) Similarly Bacon's master, Grosseteste, taught in conjunction with a doctrine of "illumination" from Avicenna and Augustine, that the action of the sense, and their true function, was such as to excite the soul to a memory of its former acquaintance with incorruptible intellgibles. While, echoing the same thesis, in the seventeenth century, Henry More declares that doubts as to the existence of innate ideas can arise only through confusion of the "extrinsecal occasion" of thinking with its "adequate or principle cause," externals being rather "the reminders than the first begetters or implanters" of knowledge (170).

VIII. But this was only the function of the sense in relation to the individual mind, the general external world built up by perception as it was considered to be chiefly significant by Renaissance neo-Platonism may perhaps best be compared to the diagram in a geometry. They assist the mind in conceiving certain relationships, which they approximately express as far as the limits of their particular natures permit, their failure, insofar as they fall short of the ideal, is not a relevant aspect of them, is not positive at all, but pure "defect." They serve as an intuitive basis for reason and discovery, but they do not embody truths, so much as derive from them, and the system of truths which may be discovered by utilising them is not only independent of them, but is not to be limited in extent and application to what can be, even remotely, represented by them. A purely empirical approach, concerning itself only with naked experience — some schools of medicine were criticised from this standpoint by Platonists — could be regarded as the attempt to establish general propositions by the study of such figures in themselves, by mechanical measurement of sides, angles, etc. an approach which not only is still driven, however it may disclaim it, to employ instruments provided by the mind, while arbitrarily excluding much of the contribution this could offer, but which at best can only arrive with much labour at approximate expressions of truths, which must remain isolated and barren since no rational account can be given of them, and which might more easily be attained by sound analytic methods. "Experience" was highly valued by Renaissance Platonism but, against such a background, evolved towards "directed experiment," and method in observation consciously and closely related to theoretical principles; for what it had come to seek in sensible "images" may be seen to have undergone an important change as compared with the objectives of earlier systems even in the same tradition. When Cusa writes that all the wisest and holiest of men, have with one accord, held that visible things are images of invisible, and reveal their Creator as in a mirror or enigma (171), he is echoing a commonplace, but nevertheless the interpretation he gives it is novel. Cusa is not seeking in the natural world a collection of disconnected emblems of moral or theological maxims such as fill the bestiaries and the catalogue "encyclopedias" of Isidore or Hildegarde, he is seeking to discover in it general laws, combining to form an overall intelligible structure of relations maintaining between its parts. These laws he regards as active products of mind, existing in mind, and knowable by mind, they are not more or less inaccurate conceptual descriptions of real occurrences in the external world, but are themselves the reality of that world. "Les lois ne sont ni des generalisations, bien qu'elles les supposent, et que le sensible en soit l'occasion. Elles sont des applications de l'esprit, des absorptions de l'experience. Le nominalisme de Nicolas, comme celui de l'idealisme moderne, implique l'existence d'un intelligible interieur a l'intelligence, fonction d'intelligibilisation si l'on peut dire."(172)

Such an attitude is connected with the belief in an underlying intelligible unity in the Cosmos. The eternal wisdom (Sapientia) which he identifies with the Logos, and Reason of things, Cusa declares is the Simplicity which relates all forms, and is the entirely adequate Measure of all things (173). But that the world is such an integral structural unity is not here an initial unsupported assumption about ontology, it is rather a conclusion from the verifiable position that mind presented with any disparate entities whatsoever can construct a pattern containing them, unite them under some generalisation (so that these as far as human knowledge is concerned largely condition their natures, defining the aspects under which they are known), taken in conjunction with the belief that the existence of such entities stems from the mind of God — to which man's intellect is, however subordinate, akin — which creates them via such patterns and "generalisations" as are available to man's mind, and by man re-fitted to the "things." Though man received a high and dignified place in such a system, yet a "Copernican" shift in the co-ordinates of reference for schematising the universe was implied. It was no longer to be interpreted, through its direct relationships, practical and moral, to man, a trend inculcated by much previous theology and in general by Christian philosophy hitherto, which took man as primary in its systematisation, and endeavoured to give adequate weight to man as a moral and spiritual being; but was to be considered via general law, the understanding of which was the most proper function of man's mind. Thus Avicenna holds "le but principal que l'etre necessaire se propose en produisant les formes, c'est l'ordre universel."(174) This order embraces a series of spiritual levels, as well as the mechanics of spatially extended phenomena, but it is no longer anthropocentric, the nature and purpose of man make up an object of study to be known through the determination of their logical place in the system. That the world was a single closely organised entity had been a general feature of Stoic writings, but despite the great influence of these in the Renaissance, particularly of the consequent ethics, and also perhaps of the stoic semantics and propositional logic on the new un-Aristotelian logics which spread increasingly, it is nevertheless the fostering of mathematics, and the teaching of the necessity of applying these in the interpretation of the laws and ordering of the

universe, a more specifically "Platonic" characteristic, that was of most importance for Renaissance scientific thought. Similarly the ancient atomic systems, which to some extent reappeared, at first sight offered similar "monisms," governed by all pervading necessity, but suffered from similar defects as regards active scientific investigation and ultimate unintelligibility as Aristotelianism. That of Epicurus, in explaining macroscopic phenomena by attributing qualities to the parts — hooked, angular and smooth atoms — drawn from suggestion of sense experience, provided little that was encouraging for further investigation, analysing the sensible world only into another equally inchoate, and almost as multifarious, but quite inaccessible to experience, testing or experimentation (175). Both it and the Democritean version avoided the major problems of Being as presented both to philosophy and science. Concentrating on the nature of individual elemental parts, neither offered any adequate explanation of the emergence, or ingression of "Wholes," neither offered means to a rational analysis of "arrangements," and "integrations," associated with such supervenient wholes or allowed such ideas status as independent, controlling "Principles" which could be derived from, and examined in the light of, a general co-ordinated system of dialectic (176).

In contrast, "parts," says Plotinus, may be assumed, and thought of, in such organized wholes as the soul with its various faculties, which he is here primarily discussing, or the universe, "in the same manner as a theorem is part of science; the whole science indeed nevertheless remaining; but the separation into parts, being as it were the utterance and energy of each. In a thing of this kind, however, each possesses the whole science in capacity, but the whole nevertheless continues to be the whole."(177). The universe as a system of interconnections, the key to which may be found in the mind, appears in Plato's own dictum, "for as all nature is akin, and the soul has learned all things there is no reason why we should not, by remembering one single thing — an act which men call learning — discover everything else, if we have courage and faint not in the search."(178) The manner in which "one thing" truly known may be pressed into unlimited service in revealing natural or spiritual mysteries is a key to many Renaissance treatments of symbols, especially so far as some of these are considered as the summary of some all embracing scheme of analogies, and it epitomises much of the theoretical foundation of the Lullian Cabalah, Dee's Monas or Bruno's "mnemonics."

Diogenus Laertius records that Speusippus who "adhered faithfully to Plato's doctrines" was accredited as being "the first to discern the common element in all studies, and to bring them into connection with each other so far as that was possible."(179) The historical appearance of theories laying man emphasis on such a "common element," as the most significant and profitable clue for investigating various sciences rather than concentrating primarily on those aspects of the nature of their subject matter which differentiated and particularised them, while not invariably associated with Platonism — it is a characteristic feature of thought drawing inspiration from mathematics or mechanics — represents generally an approach divergent from Aristotelianism. Pronouncements like "Thus through all the sciences (Music, Medicine, and Astronomy have just been correlated) many things or indeed all are in common, so far as theory is concerned," are to be found in Vitruvius (180), a source consulted and applied by Renaissance theoreticians, whose interests were far other, or extended much further than, practical Architecture. Again Raymond Lull, whose writings seem to have undergone a revival, with the spread of teachings of Pico, Reuchlin, Agrippa, etc., had aimed in the Ars Demonstrativa at inventing an art, a combination of a metaphysic and a calculus, by means of which all sciences should be demonstrable, universally and incontrovertibly: the principles of no single one were enumerated, but a method, mechanically based on an algebraic expression of syllogistic reason, is taught for discovering their common principles, on which those more particular to each may be shown to depend. In the Renaissance the De Arte Cyclognomica of Cornelius Gemma, a prominent mathematician, Copernican and acquaintance of Dee's — to name one of a multitude of works in this genre that then appeared — also presented, with a liberal use of illustrating emblems and geometrical diagrams used as metaphysical analogies, a universal method of enquiry into, and reasoning on natural, intellectual and spiritual matters. For Truths, said Culverwell, summarising the underlying dogma here, "love to spin and thread themselves into a fine continuity," and this carries as a corollary, it has been observed that "our grasp of that continuity assures us that we are sharing in the divine thought."(181) As this continuity extended through the whole of the natural world, what is perhaps a valid criticism of the original Platonic system, that it was not open to correction from experience, is inapplicable to much Renaissance Platonism, for which exactitude in material measurements, and accuracy of natural observation was frequently of the highest importance, though the real significance of the results, it might be held, was to be sought elsewhere. Its idea of the law that was to be found there led such neo-Platonism in the Renaissance to a revaluation of the

external world. For the same reasons as those on which Plotinus had attacked the Christians for despising astronomical phenomena, the Cambridge Platonists ventured to criticise Plato himself for denigrating the body. That intelligible order was to be found in nature accounts for Leonardo's reverence and devotion to factual detail — so that for example he could but himself to the considerable difficulties of obtaining and dissecting ten corpses in order to trace the course of certain veins — and could proclaim the body as an organism so much a miracle that the soul, "itself a thing divine, only separates from it eventually with the greatest suffering and grief."(182) Thus de Mornay, defending Pagan Philosophy as expressing true religion unconsciously (for as he later states "the voice of nature is the voice of truth), and, it would seem, criticizing the Averroist position, writes "To be short the marke that our faith looketh at, is the Author of Nature, and principle of all principles. The rules therefore and the principles of Nature which he hath made, cannot be contrarie unto himselfe. And he is also the verie reason and truth itselfe. All other reason then, and all other truth dependeth upon him, and relieth upon him, neither is there or can there be any reason or truth but in him: So far off is it that the thing which is trewe and reasonable in Nature, is or can be false in Divinitie...."(183) Culverwell, in the seventeenth century then, elaborating the argument that Nature is an "order or work of order" in which Eternal Law "is not really distinguished from God himself,"(184) is at once, reflecting an attitude that contemporary science was formulating with self-professed independence and originality, and yet writing well within a speculative tradition of long continuance.

Such a view of Nature, before its retrospective justification in use and application, found a congenial setting and apology in the Platonic metaphysic with which it indeed historically is most frequently conjoined. For perhaps the most fundamental characteristic of "Platonism," wherever and whenever it appears, has been its uniform refusal to separate the "logical" from the "factual," consistently regarding the essence of "things" or "facts," as that by which they become intelligible, and which is not to be looked for in the sense experiences connected with them, in their "usualness" of occurrence, or in the "customary" way of accepting them generated by habit in daily life. The foundations of knowledge are not a set of Aristotelian "first intentions," or what Russell has defended as "basic perceptive propositions." A correspondence theory of truth is replaced by a view in which all confirmation becomes a function of coherence (185). A "fact" for such a philosophy, it has been observed, "is not something objective that we apprehend outside our experience (taken as a whole), it is an interpretation of a part of experience, which other coherent interpretations of experience oblige us to believe,"(186) a view which may be developed so as to imply the denial that any specific fundamental distinction can validly be drawn between "data," and what is inferred form this or even the very process of inference itself, and to imply that they are all ontologically on a parity, and therefore only to be artificially differentiated. Thus a "thing" is real only as a "part" of a system, and considered in itself reduces to a nexus of relations (187). To be simple, to be self-subsistent belongs only to the Whole, the One, the Good, which is strictly ineffable, for being in all respects positive, embracing the full extent of the positive, it cannot ever be properly represented by discursive thought as indeed the neo-Platonic Negative Theology always taught — for which all positive assertions acquire their meaningfulness only by the implied denial made by their terms that some certain range of qualities can belong to the "entities" they refer to, since to discriminate — which is to know within such a system — is to limit and restrict. The Aristotelian objection, applicable to all purely contextual theories of signification, that to base Reality on such an unattainable absolute, leads to an infinite regress in a series of progressively more abstract discursive systems, is not particularly damaging, since the successive levels engendered by dialectic describe, as they employ more and more general and inclusive principles, an asymptotic approach to, what is defined as, the Whole. Thus from the Theaetetus it appears that, while the term "knowledge" can be applied with varying reservations relative to the status of the particular system, at a variety of levels, what is meant by "to know," without qualification of such a contextual type, cannot be accurately specified. For Plato then, it has been said, "Dialectic....while incidentally providing terms convertible in predication with "being," is not primarily a knowledge of being int he manner of Peripatetic metaphysics. It is primarily a method or an `art' of analyzing discourse by generalizing from contingent and arbitrary modes of signification so as to achieve a context free from such contingency."(188) But "dialectic" represents also the activity, and thus the actualisation of, the Intelligence, as "logic" it reveals, and has for its object, the laws governing the operations of the mind; it exhibits, which is what knowledge aims at, the conditioning principles of the patterns of relationships through which the universe can be conceived of as ordered and intelligible. Thus "dialectic" writes Plotinus, must not be fancied to be merely the instrument of the philosopher "since it does not consist of mere theorems and rules, but is conversant with things and has beings as it were for its subject matter,"

and "it proceeds in a path to beings, possessing things themselves together with theorems."(189) In this way an analysis of the syntax of logic, of the structure of discursive knowledge, is converted into a metaphysic. "Being" and the "True," "Non-being" and the "False" are equated by Plato (190) — "Non-being" representing that "deficiency" which particularises or differentiates anything, producing multiplicity, preventing the Universe from appearing a Parmenidean One; and though that which is the "True" without qualification, the ultimate Form of all discourse, is transcendent, nevertheless from it, through mediating dependent systems of discursive thought, "the objects of knowledge not only receive their being known, but their reality and essence."(191)

IX. Philosophies which have laid most stress on the a priori elements in knowledge have in general tended to turn for supporting arguments to mathematics, and, conversely, systems which seem primarily to draw inspiration from mathematical models have usually been led into elaborating theories of the a priori. In neo-Platonism the ways in which mathematics were regarded, and the uses to which it was able validly to be applied by different individuals and at varying times, were extremely diverse; it frequently meant little more than a fecund source for metaphysical analogies, emblemising and providing "insights" into moral and theological mysteries. Leaving aside for the moment the question of the influence of Platonism on mathematical development as an independent scientific discipline, and also that relating to the special status given to the "mathematicals" by Plato, which as reproduced by Dee, will be discussed in detail in a study of the Preface, the present paragraphs are intended only to illustrate some of the philosophical conclusions regarding mathematics, or those which mathematics was drawn on to support, characteristic of a neo-Platonic tradition. Many of these are crucial, for in the sixteenth century opinions on the philosophical significance of mathematics, and its relation to the natural sciences, might be taken, and there was very wide contemporary conscious recognition of this being so, as providing the most fundamental line of demarcation between "Aristotelian" and "Platonic" philosophies. A typical summary of the position is Mazzini's of 1597: "Creditit Plato Mathematicas ad speculationes physicas apprime esse accomodatas. Qua propter passim eas adhibet in reserandis mysteriis physicis. At Aristoteles omnino secus sentire videtur, erroresque Platonis adscribet amori mathematicarum."(192) Many peripatetics, Galileo complained, even "dissuade their disciplines from studying the Mathematicks, as Sciences that vitiate the reason, and render it less apt for contemplation"; and far from denying this Simplicicus replies with a justification along the usual lines: "These Mathematical subtleties Salviatus are true in abstract but applied to sensible and Physical matter they hold not good."(193) Similarly Bruno calls Aristotle an enemy to mathematics — "mathematicorum inimicus, logicus magis Aristoteles (qui plus arguendo quam argumentando valet)" adding, as Dee and many others pointed out, often with unconcealed triumph, that, whenever Aristotle touched on any profound mysteries of nature or religion he was driven to use mathematical analogy to express his meaning (194).

For Plato mathematical "objects provided (since they were knowable, being functional parts of an intelligibly connected system, and since however they might be conceived of as "existing," it could clearly not be as sensible intuitions) the most apt illustrations, by reason of their familiarity, to assist the mind in the difficult task of grasping something of the nature of those higher regions where true reality was to be sought. "For the colourless formless and intangible truly existing essence with which all true knowledge is concerned holds this region and is visible only to the mind, the pilot of the soul."(195) "That fixed and pure and true, and what we call unalloyed, knowledge" says the Philebus (196) "has to do with the things which are eternally the same without change or mixture, or with that which is most akin to them, and all other things are to be regarded as secondary and inferior." Thus "the arithmetical and metrical arts far surpass the others," and, moreover, when these "are stirred up by the impulse of the true philosopher," and proceed logically, and are not confined to merely physical things, they "are immeasurably superior in accuracy and truth about measures and numbers."(197) The Arts are classified according to the amount of mathematics they can employ, from which they gain their certainty (198): for "if arithmetic and the sciences of measurement were taken away from all the arts what was left of any of them would be so to speak, pretty worthless...All that would be left for us would be to conjecture and to drill the perceptions by practice and experience with the additional use of the powers of guessing, which are commonly caled arts and acquire their efficacy by practice and toil."(199) Hardie concludes, "The science that was not mathematical could for him (Plato) hardly be more than opinion."(200) In the Statesman measuring is called "the Kingly Art" and when intellectual activity is divided into Judging and Commanding, calculation is used as an example, and possibly meant as the type pattern of the first (201). Measurement is not merely our sole chief instrument for rectifying illusory appearances (202) but is also applicable to ethical questions, for Plato also develops the mathematical implications of the concept of "the mean" which had for long figured in classic writings (as in Hesiod's Works and Days) often with rather inexact associative, emotive reference, as the canon of ethics, and aesthetics, and the real principle of good, the well-proportioned nature producing the body's health etc. From the participation of the Unlimited — the indefinite and unconditioned — in the class of the Limited, of separated magnitude and number, arises a third class of the things making up the natural world, insofar as it is knowable; "The class of equal and double and everything that puts an end to the difference between opposites and makes them commensurable and harmonious by the introduction of number." The addition of Limit introduces moderation and allows of perfection "and thence arise the seasons and all the

beauties of our world."(203) The "science of measurement" governs the investigation of pleasure and pain judged in their relation to the Good; it is a "study of their excess and defect and equality in relation to each other" (204) while objects such as "the straight line, and the circle, and the plane and solid figures" themselves are sources of pure and "unmixed" pleasure, and while other beauties may be exhibited as imitative "the beauty of these is not relative like that of other things but they are always absolutely beautiful by nature."(205)

Such speculations however are by no means the chief feature of the Dialogue. Subsequent developments of Platonic thought gave them a more overtly fundamental position. Speusippus, according to Aristotle, "feeling it necessary to assume some direct knowledge as to the principle from which the mind proceeds to discursive thought, posited the numbers of the decad, whose propositions carry immediate convicion, and because within the decad he found the pattern of all relations and proportions of existence."(204) To affirm a thoroughgoing Pythagoreanism was a commonplace of much neo-Platonism, thus Plutarch writes in the Platonic Questions, that "the intelligence of these Ideas and forms by subtraction, deduction and division of bodies, is ranged answerable to the order of the Mathematicks, arising from Arithmetick...unto Geometry...to Astrology...and...Harmonicae....Moreover of intellectual things there is no other judge but the understanding in the mind; for cogitation or intelligence is no other thing but the understanding, so long as it is applied unto Mathematicals, wherein things intellectual appear as within mirrours."(207)

Those who treat number as separable, summarised Aristotle: "assume that it exists and is separable because the axioms will not apply to sensible objects, whereas the statements of mathematics are true and appeal to the soul."(208) This represents fairly a perennial line of argument — that mathematical procedures and the "objects" they deal with cannot be drawn from, and are clearly independent of, the sensible, but are nevertheless wholly certain, and moreover seem not to be subject to alteration by any fantasy of the mind, i.e., cannot be conceived as being other than they are discovered to be. The rigour of mathematical demonstrations, Proclus argues, is a sign that numbers and geometrical shapes are not "abstractions" from things; knowledge of them is a process of "discovery," rather than a crative act of the soul, since as the mind has not full control over them they must possess "a spontaneous substance," and if so, the soul must contain these forms, otherwise it could not know its discoveries, intellectually represented in conventional signs, as true: "Mais si l'ame fait naitre ceux-ci tout en possedant les modeles en substance, ses productions sont les emissiom des formes qui pre-existent en elle, et en disant cela, nous serions du parti de Platon et aurions trouve la veritable substance des mathematiques."(209) Augustine similarly asserts that that on which numbers are dependent, Unity, is a concept not drawn from things; that the origin of truths apprehended by the reason must not be sought at a level below the reason; and that since the conclusions of mathematics are necessary, immutable and eternal, they present the very type of the propositions formulable by the intellect which are to be distinguished as "Truths."(210)

A typical sixteenth century "Platonic" statement — such as may be paralleled in Dee's writings — on the "a priori" nature of number is Guy le Fevre de la Boderie's

> "Pource les Nombres nus d'essence toute pleine,
> Plus simple que tout corps, voire que l'ombre vaine,
> Ne sont percus des yeux, ni de l'air penetrant
> La taye du cerveau et par l'oreille entrant:
> Ils sont donc en l'Esprit qui les contient ensemble,
> Car le sense ne recoit qui ce qui lui ressemble." (211)

The Cambridge Platonists reproduce the familiar arguments. In mathematics, Smith affirms, the imagination is wholly slave to reason, in considering its truths the mind is active in the midst of realities native to itself, and the soul "converseth only with its own being."(212) He, as well as Cudworth, More and Culverwell, at times reverses the application of the argument, and argue that mathematical knowledge demonstrates the immateriality and immortality of the soul, on the principle that like is only known to like. "Immoveable essense" (such as a triangle exemplifies) were, according to Cudsworth, the only true objects of knowledge, and "the essence of geometrical figures and all the system of truth that flow from that esssence are involved in the very nature of rational thought and could not be arbitrarily brought into existence or changed by our thinking."(213) A similar argument, suggested by geometrical figures, was used by Descartes: "Quodque hic masime considerandum puto, invenio apud me innumeras ideas quarundam rerum, quae etiamsi extra me fortasse nullibi existant, non tamen dici possunt nihil esse; et quamvis a me quodammodo ad arbitium cogitentur, non tamen a me finguntur, sed suas habent veras et

immutabiles naturas: ut cum, exempli causa, triangulum imaginor, etsi fortasse talis figura nullibi gentium extra cogitationem meam existat, nec unquam existet, est tamen profecto determinata quaedam ejus natura, sive essentia, sive forma, immutabilis et aeterna, quae a me non efficta est, nec a mente mea dependet, ut patet ex eo quod demonstrari possint variae proprietates de isto triangulo...."(214) The strength of the appeal of such arguments is witnessed by the fact that while they, and the position they support, were closely associated with confessed neo-Platonism during the Renaissance, both have survived essentially the same, through large changes in philosophical and religious context. There are not lacking today examples of prominent mathematicians who have thus defended the "objective reality" of their science (215).

Dee's position in this, and in many other respects, was consciously approximated to that of Roger Bacon; whose reputation he championed against suspicions of necromancy, and who, perhaps of all Dee's predecessors, received the most frequent and unqualified praise from him. Fastening on the incident of the slave in the Meno, which he had found reproduced in Cicero, Bacon argued from it "wherefore since this knowledge (of mathematics) is almost innate and as it were precedes discovery and learning or at least is less in need of them than other sciences, it will be first among sciences and will precede others disposing us towards them." Distinguishing between our inferential, and mediated knowledge of nature and its processes in general, and the truth of actual occurences in these which is in general only apparent to God, he asserts — foreshadowing a famous declaration of Galileo's — "but in mathematics only....are the same things known to us and to nature simply."(216) He extends the familiar position that, as Synesius expressed it (217) mathematical propositions are certain above all others, and theother sciences are consequently proud to borrow whenever possible demonstration from them, into the grandiose aim of "per vias mathematicae verficare omnia quae in Naturalibus scientiis sunt necessaria."(218) This must be achieved because "in other sciences the assistance of mathematics being excluded there are so many doubts, so many opinions, so many errors on the part of man that these sciences cannot be unfolded," which is so, since, Bacon observes, in natural sciences and in much of metaphysics reliance has otherwise to be placed on arguments which are doubtful, since they proceed from effects to causes, and cannot demonstrate — as is the only certain method — from an initial grasp of "necessary causes" — adding "and likewise neither in matter pertaining to logic nor in grammar, as is clear, can there be very convincing demonstration because of the weak nature of the materials which those sciences treat." Thus investigation by "dialectical and sophistical argument as commonly introduced" must be rejected; mathematics must "enter into the truths and activities of the other sciences, regulating them, without which they cannot be made clear nor taught nor learned," and this "simply amounts to establishing definite methods of dealing with all sciences."(219) A recurrent theme is concerned with logic. Bacon, by exhibiting the implicit syllogisms in the natural actions of children or animals, claims that logic, however formally it can be expressed, is inherent in nature, and known innately (220), but that it is less fundamental in this respect than mathematics, and should be formally derived from it. He is reported in notes of lectures delivered by him, recently discovered, as declaring, after describing the interconnection of all sciences, the key to which is mathematics, "Volo probare quod non potest homo docere Logicam nisi sit optime in mathematicis imbutus....quoniam mathematicas docens potest et descendere ad Logicalia et grammaticalia quia in eis instructus est"; and he proceeds to a consideration of the categories, claiming that the meaning of each is gained through what is only clearly known quantitatively, concluding "dico ergo quod liber Posteriorum sine Arismetics et Geometria non scietur."(221)

Similar themes appear in Cusa, whose works Dee also seems to have prized highly and whose statements on mathematics were often quoted in prefaces to sixteenth century editions of Euclid. The mind, declared Cusa (222) intending it to be no more metaphysical expression, was a measuring instrument, to know was to ascertain the true proportions of things. In Idiota (223) a supposed etymological connection of "mens" and words relating to measuring is urged in support of the view that the true function of thought is to endow all things with limit and measure. All judgment, the first chapter of de Docta Ignorantia claims, is a comparison of a thing to something presupposed, and hence the determination of a proportion between them; all conclusions are therefore comparative, while all things susceptible of proportion are included in the scope of number. The spread of such views in the Renaissance gained impetus from the increasing reimportation and emphasis on the importance of logical rigour into mathematics, a consequence of the revival of the full text of the Elements, the discovery of the writings of Archimedes and the development of Algebra. This was in sharp contrast withthe impression that the form in which Boethius transmitted Euclid to the middle ages, or the number theory as set out by Theon, might give; for there, propositions, while they might be admitted as certain and undeniable, appeared

rather as isolated truths, and the secret of their essential connection was an open question for metaphysical speculation. "Perfect" and "Amicable" numbers might still be so regarded by mathematicians of the Renaissance, but their attention was now orientated chiefly towards the way in which conclusions could be proved to be true, by strictly mathematical methods, even though apparently intuitively recognisable as so being, or discoverable by "experience," rather than to presenting mathematics as a collection of individual "factual statements" about numbers or figures. Declarations that mathematics exemplify Reason, and provide the pattern for philosophical procedure, and even its matter, become more widespread and have a somewhat different implication in the late fifteenth and sixteenth centuries than in the earlier times, and even when used apparently purely rhetorically are not without significance.(224)

X. Since the works of Dee which will be described in subsequent chapters are concerned mainly with more particularised problems, the foregoing sections have been designed to illustrate some of the generalities which helped to frame the philosophic background of his thought, both from sources utilised by Dee himself or from those, such as the Cambridge Platonists, of following generations whose doctrines, though conveniently more explicit, are closely concordant with his own, and if more developed are yet related philosophical formulations within a single intellectual tradition. Something must also be said however of the ways in which the views and activities of such thinkers as Dee influenced or proved complementary to the outlook and methods of the "new" science of the day. One contrast between this and the older orthodox natural philosophy has been succinctly shown by Collingwood: "For the Aristotelian doctrine that change is an expression of tendency, the sixteenth century substituted the Platonic doctrine — strictly the Pythagorean doctrine for in essence it is pre-Socratic — that change is a function of structure."(225) A consideration in terms of structure, that is, the attribution of causal efficacy only to preceding and therefore probably determinable structural relationships, suggests at least the possibility of a complete analysis of apparently disparate entities or "events," on some common quantitative scale; for structure is amenable, as "innate tendency," dependent upon the whole synthetic form of the object in process of change, is not, to mathematical description. The differences in the changing object, though accompanied by widely contrasted qualitative accidents, may in this way perhaps be reduced to a matter of comparable degrees; it becomes a not impossible speculation that all observable characteristics may result from the imposition of a certain intelligible order upon some primary undifferentiated stuff, of which the only necessary property is to be "susceptible of arrangement," and that the secrets of all generation and decay, the reality of all natural phenomena may be exhaustively expressed, as Dee never wearied of asserting, in terms of "Number, Measure and Weight." The sphere in which teleological explanation was admitted — a philosophy which did not abandon a spiritually significant eschatology could clearly not dispense with it wholly — became more narrowly restricted, and action through time increasingly accepted, as being for the purposes of the natural sciences, irreversibly unidirectional. The "mechanism" that this suggests as an almost inevitable consequence may indeed be no more than a teleology a rebours, but at least possessed the advantage as a working procedural guide that it did not assume in advance as a working procedural guide that it did not assume in advance that any of the factors determining change were, ipso facto, inaccessible to observation.

The evolution of a concept of "structure" in nature, with such implications, in the Renaissance is best viewed in relation to two themes, in many respects only artificially separable. The revival of "the neo-Platonic interpretation of Plato dominated by the passion for a fully articulated vision of the world as a structural entity,"(226) and the attempt to extend as far as possible methods of quantitative analysis to natural questions which accompanied the rapid progress in the theoretical development, and the spread of knowledge of mathematics. The former body of doctrine stood firmly on Plato's declaration that "we are sure of this....that whatever is completely, is completely knowable, and what in no way is in everyway unknowable," and, by refusing to separate Being from a logical account, developed such a theory of knowledge as Cusa's: that the function of thought was not to discover and examine particular discrete and self existing entities and to build the world from the abstractions drawn from a grouping of their natures so considered, but to establish intelligible relations, and a hierarchy of more and more comprehensive laws; that "vere soire est per nexus soire." The neo-Platonic picture of the universe of St. Augustine had not in general statement been very different from that now revived — "une matiere impregnee d'intelligibilite par les idees divines: tout y est ordre mesure et nombre, les formes des corps se reduisent a de certaines proportions numeriques et les operations de la vie se deroulent, elles aussi, selon les lois intelligibles des nombres. En droit l'univers est intelligible pour une pensee capable de la connaitre comme tel."(227) But its revival in the world of the Renaissance had novel consequences and led to, and was used in defence of, "a habit of detailed and accurate observation, based on the postulate that everything in nature however minute and apparently accidental, is permeated with rationality and therefore significant and valuable."(228)

The Timaeus hinted at the metaphysically satisfactory account of the mutual relationships between meaning or purpose, and discoverable mechanical causality, which was most compatible with such views. The latter was the temporal unfolding in discursively intelligible form and therefore inevitably limited, and bound by necessity arising from the nature of the selected medium of its expression, of timeless values. These, though "causes," in the sense of providing explanation required by the soul, did not intrude actively into the temporal flow of events; though Reason was an agent there, conceived of as operating as man's mind appears to allow him to do, rearranging and controlling events, but only in accordance with Necessity and natural law. The

ultimate values could be thought of as the limit defined by the automatic universal development. "We must accordingly," says the Timaeus, "distinguish two types of cause, the necessary and the divine. The divine we should search out in all things for the sake of a life of such happiness as our nature admits; the necessary for the sake of the divine, reflecting that apart from the necessary those other objects of our serious study cannot by themselves be perceived or communicated, nor can we in any other way have part or lot in them."(229) It is probably on this section of the Timaeus that Boethius bases his version of this doctrine, developed in terms of Fate and Providence: "For Providence is the very Divine reason itself seated in the highest Prince which disposeth all things. But Fate is a disposition inherent in changeable things by which Providence connecteth all things in their due order. For Providence embraceth all things together, though diverse, though infinite, but Fate putteth things by which Providence connecteth all things in their due order. For Providence embraceth all things together, though diverse, though infinite, but Fate putteth every particular thing into motion being distributed by places forms and times....which although they be diverse yet the one dependeth upon the other....Providence is an immoveable and simple determination of those things which are to be done and Fate a moveable connexion and temporal order of those things which the Divine simplicity hath disposed to be done."(230) Such a teaching Cusa probably refers to when discussing The Soul — or Form — of the Universe. He says that some have called the general type of causality (that superior nature, which is responsible for all change and process), Spirit, or intelligence, others the Soul of the World, others destiny concealed in substance, but the followers of Plato call it a necessity of structural constitution.(231) Leonardo, who held that the body is the first great work of the soul, being its realisation through matter of its ideal of the human form, found in such views the reconciliation between this thesis, which involves a hierarchical superiority of the spiritual over the material, and a theory of nature as exhibiting only mechanically describable, controllable and mechanically reproducible phenomena, from which last position he developed his method of investigation. Charbonnel, who on this point finds Leonardo's thought recalls both Plotinus and Bruno, thus reproduced it: "La necessite est le lien eternel, la regle de la nature mais en definitive elle se confond avec la raison. Ce qu'il y a de primitif, c'est l'intelligible, c'est la raison vivante souveraine, dont la nature est l'expression visible. Savoir c'est approfondir l'esprit et ses lois. Par l'etude des faits nous sommes ramenes du dehors au dedans, de la realite a l'idee...."(232)

The elevation of mathematics to the position of the primary instrument of the intellect for the analysis of nature also found theoretical inspiration in the Timaeus, even though its particular exemplifications of the results obtainable by such a method might not themselves be taken over as dogmas. Atomism always represents the pursuing of uniformity into the very elements of things, and the geometrical atomism of the Timaeus exhibited the apparently primary substances of earth, air, fire and water, still figuring as ultimates in an Aristotelian physics, as constructs of intelligible concepts; it had also attempted physical explanation in mathematical terms of such qualitative phenomena as colour diversity. It suggested a general framework for thought capable of embracing all things and a uniform language for the expression of all conclusions, thereby intelligibly and firmly connecting them together. Its great power and promise lay in abolishing what in Aristotelian thought sometimes appeared unbridgeable gulfs between "things," "facts" and "laws"; for, though on different levels all these must in essence always be abstractions, they were now abstractions made on identical principles, and their interrelations capable of clear examination. What the Timaeus precisely meant for the scientific mathematicism which began its modern career in the Renaissance, Brunschwieg has thus described: "En utilisant par un raisonnement assez insolite ( ) les maigres ressources de la science de son temps. Flaton fait oeuvre de prophete plus que de precurseur: il delimite du dehors le terrain ou s'elevera l'edifice de la pensee moderne."(233)

Among a large body of Renaissance thinkers an increasing dissatisfaction is discernible with the Aristotelian logic insofar as it laid claim to be of assistance to constructive thought. A reduction to syllogistic form might be a useful touchstone for consistency in thinking after any creative process was over, but its impotence in all other respects became increasingly remarked: "Logic, it appears to me," declared Galileo, comparing it unfavourably with geometrical method, "teaches us how to test the conclusiveness of any argument or demonstration already discovered and completed, but I do not believe that it teaches us to discover correct arguments and demonstrations."(234) The syllogism employed, as its extreme advocates recommended, as an engine for the investigation of nature involved from an empirical standpoint a palpably vicious circle, for then interpreted purely extensively (as forming part of a scheme of class inclusions), the transition from the universal to the particular could bring forth no new knowledge, since if the former represented no more than the invariable association of a set of characteristics abstracted

represented no more than the invariable association of a set of characteristics abstracted from observation of particulars, these must previously have been identified as present in the particular, which figures in the conclusion, when it was subsumed under the universal in the premise. The form of Aristotelian induction, associated with such a logical method, was found equally unsatisfactory. Only induction by a simple and exhaustive enumeration could be formally valid, but to escape the difficulty here by asserting that although this could rarely be done with particulars it might be with species, or else to rely on the rational intuitions, possessed by gods (or rather separated spiritual substances such as angels, for Christian Aristotelians) and men, as being able properly to extract from a few cases a universal of this kind that could operate as a middle term in argument, proved especially in purely physical questions (relating to motion for instance) merely misleading. Again though all definitions amount to the enunciation of some particular properties selected as characteristic, yet those of mathematics by permitting an exhaustive "construction" of the entity described, involved implicitly all other truths about it, which though initially unknown or unobserved, might thereupon be validly deduced from the implications of the definition itself — at the same time, since often many alternative definitions of equal adequacy were here possible a practical refutation of Aristotle's claim that all things had a single "essence" that could be expressed in one "true definition" only was provided. On the other hand if deduction claiming to establish genuine new knowledge were attempted syllogistically, employing synthetic definitions of the kind Aristotle recommended then it would in fact appear successful only when an unjustified importation of "meaning" into the terms figuring in the premisses, in excess of that attributed to them by definition, had unobserved, by psychological sleight, taken place. (An attack on the claims for the syllogism made by Aristotelians, along these lines occurs as Morsenne's Verite des Sciences — it embodies, Morsenne argues, no implications of ideas or causes but only a formal arrangement of elements observed as usually empirically associated. If man possessed Intuition equal to that of the Angels, both the minor and the conclusion would be seen to be unnecessary, they would be known immediately as present in the major; as it is, this last is established only by an induction from particulars, a procedure which has not been universal, else there would be no new particular to appear in the minor to which the conclusion relates — and hence remains always to some degree uncertain (235).) The "purely verbal" nature of syllogistic reasoning which while by its form it seemed to compel the reason, yet in its matter all too frequently remained thoroughly unconvincing for the understanding, became glaringly apparent in the light of many of the acute and genuine problems of sixteenth century thought.

It may well be, as F.C.S. Schiller insisted, that the sole alternative to a logic which comes to terms with psychology (thus ultimately abandoning any claim to be absolute and eternal) is one enslaved to grammar (236). It would seem that much of the popularity of Ramus' logic, among Platonists, humanists, and the new scientists, was due to the impression it gave at the time (as distinct from any final historical judgment on it as a system) of being a method directly drawn from, and remaining much closer than the Aristotelian to, observable natural mental process, of truing to base itself on the way terms are in fact used in thinking, and of being a new and profound attempt to investigate actual meanings, and evolve a formal method which should take into account that these are always relative to purpose. Nevertheless a logic "enslaved to grammar" offers the great advantage of providing absolute, demonstrable certainty through formal manipulation made in accordance with merely syntactical considerations. Such a system, having such advantages, the Renaissance found in mathematics, and this moreover apparently resolved the antinomy which syllogistic reasoning was incapable of doing, that if a logic is to be of value it must be able to produce conclusions which are of intelligibility — an example is Malebranche's declaration that that could only be accepted as a true cause, between which and its effect the mind perceived a necessary connection as clearly as it did the equivalence that a series of substitutions could establish between two terms of an equation in algebra (239). It was an ideal suggested by mathematics and which applied to physical questions — and it is problems of method in natural philosophy that Malebranche was here treating of — it led inevitably, though not immediately, to mechanism ("Le mecanisme" it has been claimed "prend comme terrain solide de construction l'unite profonde de l'intelligible et de l'experience, du pensable et du representable, du rationnel et du perceptible"(240)). However much it might represent the limit of already acquired knowledge in some subjects, an inference of cloven hoofs from the observation "horned" by way of the form "ruminant" functioning as cause, was no longer in even remote conformity with the, ideally, demanded pattern of scientific procedure. The Cambridge Platonists were to receive more encouragement from the practical science of their day in believing that the division into "forms" and "matter" could be dispensed with yet in rejecting these as false and artificial, and replacing them by the terms "body" and "spirit" and removing all teleological considerations from "body," they were

developing the position of many predecessors in the Renaissance. But conscious life which could be observed to act in relation to an end — though only in accordance with the prior representation the mind framed of this, which alone and not the "end" itself could therefore properly be regarded as "causal" — this class of conscious volitional actions, taken together with that of physical phenomena mechanically explicable, did not suffice to entirely account for natural change and generation. The solution usually adopted by those who forsook Aristotelianism was to ascribe what remained to the "seminal reasons," which the stoics had employed and which combined the advantages and avoided some of the difficulties of both the Democritean atoms and the Ideas of Plato (certainly in the original form in which these had been put forward). Augustine had made large use of this concept and it had subsequently had a lengthy and respectable history in philosophic thought. Sir Thomas Browne still found it a useful hypothesis, offering, for want of better, a plausible shadow of explanation (241). It at least avoided the dangers of a theory which would have directed speculation towards considering the final entelechy of a form rather than observation towards conditions of development.

Aristotle had thought it a cogent argument to urge against the Pythagoreans that number could not be admitted as the essence of things nor the cause of the form, for the reason that essence was always a ratio (as the essence of skin and bone was to be three parts fire and two of earth) and number was merely adjectival, signifying an amount of matter, an intensity of quality (242). This could not serve as valid criticism against the procedure of the Renaissance neo-Platonists, who were not solely, or perhaps chiefly concerned in subsuming a thing under some one cardinal number, binding them together in a mesh of allegory, and so interpreting nature through the supposed mystic properties of the numeral system. Rather they accepted this statement (implied for example in Dee's treatment of medicine graduation), but turned its force against Aristotle, by asserting that all that could be certainly known of the nature of the terms figuring in the ratios compounding essence was in turn merely other determinable ratios that they observably entered into. The key to nature was therefore still mathematical, but it lay in the application of what Dee always referred to as "The Divine Science of Proportion" — a title originated by Paccioli. The change of orientation that was initiated in the Renaissance, and has since, evolving persistently, maintained ascendancy by this new approach, has been delineated by Blanche: "En l'adoptant, la pensee transformait du meme coup sa propre structure et s'obligeait a une revision intellectuelle totale. La hierarchie allait desormais se renverser entre les sens et l'entendement, entre les choses et les rapports. L'idealisme de la relation allait se substituer au realisme de la substance et a l'idealisme de la representation, et une forme nouvelle de realite se faire une place entre le monde anthropomorphique de la perception et le monde transcendant de la speculation, entre le phenomene et la chose en soi....Le concret ce n'est plus le qualitatif, dans sa diversite pittoresque, et d'ou l'abstrait se forme par reduction, c'est un entrecroisement de determinations intellectuelles...Le reel n'est plus au point de depart, mais au terme de la connaissance. Il n'est plus donne a la sensibilite par les qualites d'une substance il est construit par l'intelligence comme un systeme de rapports."(243) The Renaissance mathematicisation of the world already contains in embryo the definition of scientific knowledge of Eddington — that any account of the external world "involves unknowable actors executing unknowable actions," which are nonetheless a vehicle for "The knowledge we can acquire [which] is a knowledge of a structure or patter, contained in the actions."(244)

The new methods in action and the visible manifestation of their power are more clearly apparent in a generation later than Dee's. But the same doctrines, for which Dee out of faith was a largely theoretical propagandist, were held by the much greater and more creative Galileo, who refashioned the world out of them in a way that could not be ignored. Mathematics, Galileo asserted in the Dialogues of the Two Principle Systems was the one type of knowledge in which man's knowledge though less in extent was necessarily the same in kind as God's (245); it was therefore a domain in which reality and God's thoughts could be immediately attained. "La filosofia," he declared, "e scritta in questo grandissimo libro, che continuamente ci sta aperto innanzi a gli occhi (io dico l'universo) ma non si puo intendere se prima non simpara a intender la lingua e conoscer i caratteri, ne'quali e scritto. Egli e scritto in lingua matematica e i caratteri son triangoli, cerchi ed altri figure geometriche, senza i quali mezzi e impossibile a intenderne umanamente parol, senza questi e un aggirarsi vanamente per un oscuro laberinto."(246) He seems to have consciously accepted without serious doubts, that the mathematical methods he employed were inseparable from a Platonic theory of knowledge and metaphysics (247); and recent research has corrected older views on the empirical elements in his work and its supposed contrast with earlier science, in showing that where ever he rejected the Aristotelian physics or method, Galileo's "did not revert to mere observation but on the contrary reverted to a more vigorous form

of Platonic rationalism, in which observed nature is merely an instance of a universal geometric order of infinite complexity."(248) "On pourrait dire," Professor Koyre has written of Galileo, "...qu'il n'a aucune confiance en une observations non verifiee theoriquement. L'epistemologie galileenne n'est pas positiviste. Elle est archimedienne."(249) A statement strikingly illustrated by the true version of the Pisa episode, which exhibits Galileo as unshaken in his faith in the reasoning which demonstrates contradiction in the Aristotelian position — two equal weights tied together cannot double their rate of fall merely by being so conjoined if their single rates were equal when they were separate, since the velocity of neither can increase that of the other; while a lighter weight attached to a heavier, should on the Aristotelian premisses both result in a faster rate of fall, and by composition of their respective velocities, a slower — and presents him as merely referring to this argument when his opponents claim to vindicate Aristotle by experiment from the leaning tower, dropping wood and lead of equal volume, the lead reaching the ground invariable three cubits in advance of the wood (250). Galileo's attitude is exactly that expressed in the declaration made by Descartes after dealing with the laws of shock: "Et les demonstrations de tout ceci sont si certaines qu'encores que l'experience nous sembleroit faire voir le contraire, nous serions neanmoins obliges d'ajouter plus de foi a notre raison qu'a nos sens."(251)

An inspiration and a model for Galilean science was the successful and apparently a priori method followed by Archimedes in mechanics. Indeed those very features were fixed on in the Renaissance as being of the highest value in it that have been singled out for criticism by a later positivism; thus Mach, from the general thesis that mathematical reasoning is powerless to discover experimental facts, criticises Archimedes' treatment of the lever, for disguising his premises as definitions and axioms claiming to be self evident, when they can be no more than the results of general resumes of and abstraction from common experience (252). Nevertheless it was through the use of similar methods, that Galileo, Stevin and others were able to complete the foundations on which the edifice of all later mechanics has been raised. In contrast to the vast collections of "cases" recommended by Baconian induction, the small number of experiments that was here found necessary is significant, and many of these were, or in the unfamiliar formal exposition could be replaced by, such as were of an entirely "Ideal" character — that it was not necessary to realise, since the result was evident as soon as their conditions were stated. Such an experiment is that by which Stevin demonstrated the principle of the composition of forces, after which "le developpement complet de la statique n'etait plus desormais qu'un probleme purement geometrique et analytique."(253) The general appeal to experience made by Aristotelianism, only analysed in accordance with concepts based on synthesized perceptions, cannot, as these purely theoretical demonstrations can, be granted the title of "experiment," in the same manner in which the term is applied today to scientific technique in even its most empirical aspects.

XI. To substitute "structure" for tendency, or rather to regard "tendency" as a feature arising from structure as neo-Platonists and mathematical philosophers were led to do in the Renaissance, is of course, ultimately, to replace "quality" by "quantity" as the most important feature of nature, and as the determinant in causal operations; and this was widely recognised at the time. But such a step was compatible with Platonic, as it was not with Aristotelian, thought. The Platonists, Aristotle had argued at length, as much as Atomists, reduce all things to quantitative relations (254). The Timaeus gave support to later scientific theory, by rigidly separating matter from form, which was its intelligible and]i arrangement (thus surpassing qualitative atomism); "Durch diese Scheidung kommt er (Plato) zu dem, was den ersten Stofftheorien der Ionier als Ahnung zugrunde lag: er fasst die Elemente als Erscheinungsformen als Aggregatzustande eines einzigen unwandelbaren und qualitatslosen Grundstoffes. Das ist die grosse Leistung Platons, die der Geschichte der Physik angehort."(255) Matter, argues Plotinus, has not qualities in itself; they are imposed by the mind and recognised in the illumination of it by mind (as air can be made luminous while remaining still itself invisible). Magnitude, limit, and number are what are first imposed upon it before any other forms may be, and its participation in these determines of what other forms it may then be the recipient (256). Physics, Avicenna held, and for this Averroes attacked him, must study bodies not as "being," or "matter" and "form," but solely spatially and as they are in motion or at rest (257). Crescas in his criticism of Aristotle, states many positions held by Renaissance Platonists to whom his work was well known, distinguishes sharply between the "separable" and "inseparable," or the "external" and "inherent" accidents of bodies, and as necessary accidents (as against Aristotle's list of nine) he allows only the mathematical three — quantity, figure and position (258). Such a view, which amounts to a distinction into primary and secondary qualities, is native to a Platonic philosophy, long before seventeenth century thinkers build their new systems in terms of it. Again, the doctrines of absolute space — an existent, geometrically propertied framework of the universe — reaches Newton through Gassendi and Henry More, and had been previously advocated by Campanella, and by Patrizzi, who declared Space to be the first thing created by God extra se, that it was prior to all nature, and therefore the study of mathematics must precede the study of nature, which must be investigated through them (259). Dee also employs such assumptions, and indeed they appear in Crescas who attacks Aristotle for holding that "dimensions" are the property of bodies, claiming they are a property of space, which underlies even the void (which he accepts) and are thus "immoveable."(260)

Proclus had declared that all forms of mathematics could be reduced to the same principles of operation, and these extended to the interpretation of all things that are (261). Dee did not question this. He and other thinkers, who then also advocated the penetration of all natural science by mathematics, are indeed as explicit as Kant: "Ich behaupte aber, dass in jeder besonderen Naturlehre nur so viel eigentliche Wissenschaft angetroffen werden Konne, als darin Mathematik anzutruffen ist," and their supporting reasons, though expressed in a different idiom, may be without undue distortion correlated with his (262). Nevertheless it was, understandably, inevitable that to dethrone quality for quantity and to profess a belief as Dee would seem to have done, that the world ought to be fully describable by means of "Number, Measure and Weight," and that it was only human deficiencies, limitations, and illusions, some correctable, some ineradicable, that prevent man doing so or fully conceiving reality in these terms, was in the sixteenth century frequently branded as mere perversity. For it is all too obvious that all that seems to be ever directly experienced by man takes the form of qualitative percepts, and on experienced quality, on the world, as directly known by sense and synthetic image, solidly rested the Aristotelian physics; it was propped by the whole weight of every man's ordinary every day experience and "common sense," and in accordance with the standards, and from the data these provided, it began its inductions. To hold the opposing view involved a more than extraordinary faith in mathematics. Copernicus' particular form of saving the appearances, for example, could appeal only to that minority who were prepared to make formidable philosophical, and, as it emerged, perhaps religious change ("I have turned the whole frame of the world, and am thereby almost a new Creator" are the words Donne puts into his mouth (263)) subordinate to the doubtful advantage of an aesthetically simpler and more harmonious mathematical account of the tracks of some few distant points of light across the night sky, an account moreover which violated generally accepted physical assumptions in the interests of a purely a priori principle, seemingly largely to be of merely academic interest, the principle of "equal motion." Moreover "The three leading senses," as Lord Brooke pertinently commented, "have confuted Copernicus these many years, for the ye seeth the circulations of the heavens, we feele ourselves upon a stable and firm foundation and our eares heare not from the volutations of the Earth such a black Cant as her heaving rowlings would

rumble forth: and yet now if we will believe our new Masters sense hath done as sense will do, misguided our reason."(264)

Dee, while he never in print committed himself to the Copernican system, championed the principles from which it took its source, and made a lifelong defence of the virtues of mathematics. The gradual triumph of such views was to change the whole appearance of the scientific universe, and already in the succeeding century "just those qualities are seized upon as fundamental in nature which it has been found possible by Newton's time to handle by the exact mathematical method."(265) For Galileo a physical object is merely a mass in space and time, all else is contributed by the observer. Man's sensations of things (light is an instance) Descartes argued, are, as compared with their reality, exactly what the mere sound of words are to their meanings, they are the conventional signs of nature (266). "We conceive this atomick Physiology," writes Cudworth, who declares it to be "Mosaical," "as to the essential thereof to be, unquestionably true, viz that the only principles of bodies are magnitude, figure, site, motion and rest; and that the qualities and forms of inanimate bodies are really nothing but several combinations of these, causing several phancies in us," (267) and thus held that "knowledge of the real qualities of the external world must be sought in the application of rational mathematical principles to the world of pure extension," for the principles of such knowledge would be purely native to the mind, clear, universal and necessary, arising from the same logic of God which created the world (268). It is clear from such seventeenth century statements that the claims of intuition have already been largely surrendered; future change and subtilization in the picture of the world which science thereafter takes as "real" become more and more purely a function of the development of an accepted methodology in its inevitable self-unfolding. "Things" Russel has declared "are those series of aspects which obey the laws of physics," (269) and Jeans: "The final truth about a phenomenon resides in the mathematical description of it; so long as there is no imperfection in this, our knowledge of the phenomenon is complete."(270) The fundamental thesis of such a position is apparently the equation of the "reality" of an object or event with the form of description which embodies all the operations necessary for an exact reproduction of it, e.g., that, since an algebraic equation, involving three Cartesian co-ordinates, may be constructed which will fully and exactly describe and permit the perfect duplication of, any surface whatsoever, such a formula could be given, and be regarded as the scientific essence of the Venus de Milo; or again, a piece of music issues from a gramophone as an effect of the curve described by the needle on the disc, therefore "les qualities si complexes que les auditeurs attribuent a la composition et a l'execution appartiennent a cette courbe, puisque cette courbe suffit a les fair revivre."(271) Nevertheless a grave problem arises, "a very little reflection," wrote G.H. Hardy, "is enough to show that the physicists' reality whatever it may be has few or none of the attributes which common sense ascribes instinctively to reality. A chair may be a collection of whirling electrons or an idea in the mind of God, each of these accounts of it may have its merits, but neither conforms at all closely to the suggestions of common sense."(272) The long history of creative achievements of science has perhaps largely palliated the disturbing effect of this dichotomy for the practical scientist, and engendered a confidence which can view the problem as a mere irrelevance, certainly not pressingly requiring resolution. It was far more acute for the would-be Pythagoreanisers of the Renaissance, and the novelty of their methods could not find adequate excuse from past successful use, but was driven for its apology to Philosophy, while to hold that in abstract thought only mathematical demonstration, in physical questions only what could be exactly measured and reduced to quantitative expression, were wholly certain was a thesis which although itself easily defensible, could, especially at this time, only teach either a lesson in scepticism or imply the necessity of some Pythagorean, perhaps mystical metaphysic: and on the whole, the temper of the Renaissance was not one inclined to rest in mere phenomenalist scepticism (273).

The new attention to mathematics was not totally lacking in immediate advantages. Certain hoary problems of the older physics could now be simply solved. A sign of its rapidly increasing connections with, and importance for, the needs of contemporary society is the large number of navigators, instrument makers, surveyors and others of the swelling technical artisan classes, who sympathised with, consulted, received instruction from, or acknowledged a debt to Dee and other theoreticians. But such factors can be easily over estimated (274). Mathematical "discoveries" do not run parallel in time with their applications. The initial stimulus to such research is seldom some known physical need; the "use" of the results, if and when it occurs, appears as a second, almost "independent" discovery (275). But while no practical end may be available as motive for these pursuits, the lack of one is sometimes felt. A modern mathematician writes on this subject: "I suppose that every mathematician is sometimes depressed, as certainly I often am myself, by this feeling of helplessness and futility....It is possible that the life of a mathematician is one which no

perfectly reasonable man would elect to live."(276) Mathematicians in the sixteenth century were to some extent perhaps protected from such a "feeling of futility," it is true, by the spontaneous enthusiasm accompanying the discovery in ancient and Arab writings of vast new territories for mathematical exploration, but also very often and more fundamentally by some philosophy, usually of a kind that can be clearly associated with neo-Platonism, which taught that number relationships possessed in themselves transcendental value, and could, as it were, speak significantly to the soul. This had its own dangers.

Such philosophies offered a new criterion of Reality, in judging the external world. There may of course be an indefinite number of possible criteria of this kind, but the use of some or other of them is invariably indispensable, for the term "Reality" insofar as it is thought to denote anything positive or is attached as a supposedly meaningful description to any entity or occurrence, whenever it is employed in contradiction to that which is rejected as "illusion" or "mere appearance" is, while masking as an ontological statement, clearly dependent on value, and merely indicates that some evaluative, discriminatory operation has been made. "The real," Professor Dingle has summarised, "is that to which we attach most importance"(277) — one may compare Nietzsche's "To know is only to work with one's favourite metaphors." In daily life such discriminations in appearance are made to a large extent automatically and by acquired habit; they are necessary to the simplest form of practical thought; for all the aspects and qualities which make up the concrescence of what is distinguished as an "object," even of the most primitive kind, can never be presented to the sense together at the same time, while the presentations offered at differing times will involve contradiction if all are to be unconditionally and uncritically accepted. Distinctions of levels of reality among such various presentations are hence unavoidably always made (the penny is round though it appears elliptical from every point of view but one), and made in accordance with some Idea of the thing, constructed from selected privileged aspects, accepted as representing its permanent, or true nature. These as made by common sense in every day life, produce small scale, local, coherency, but without reference to, and often totally discordantly with, any large scale or overall coherency, for which no pressing need is felt; but to establish such a scheme, to supply a logical account of all appearance, is one of the primary problems all philosophies have found confronting them. But though the universal initial motive of all such systems may well be to "save the appearances," an orderly scheme of thought cannot be constructed which admits all of these on an egalitarian basis, or rather the more it would attempt to do so the more it is driven to explain them in terms of something else, if intelligibility is to be achieved at all (the Heraclitean honey which is both sweet and bitter, is something far different from any experienceable honey merely because it pretends to be only a compound of all actual experiences). "The heart of the new scientific metaphysics," as it was developed in the seventeenth century, Burtt observes, "is to be found in the ascription of ultimate reality and causal efficacy to the world of mathematics, which world is identified with the realm of material bodies moving in space and time."(278) Some illustrations of the relationship of such a view with neo-Platonism have already been given; mathematics exhibited an a priori certainty, so that here the philosopher could be sure as Macrobius, and other Platonists had generally stressed ,that he was dealing with "metaphysical existences that are, while things corporeal appear to be."(279) For the peripatetics mathematics was, whenever it could be legitimately applied, only an approximate, because abstract, account of the external world, whose reality was far differently founded; to Platonists the world was rather an approximation to a mathematical truth by which it was ordered.

One of the strongest arguments at the disposal of the new thought in the sixteenth century was the apparently exact correspondence between the results to be gained from empirical evidence, intuition and logic, offered by Euclidean geometry — a "fact" which could, validly, be considered of the highest importance to philosophy until the mid-nineteenth century (280). But just as the germ of all the mystical Pythagorean theology may have been the factual observation of the correspondence maintaining between the lengths of string producing the notes forming the consonant intervals of the scale and the first four cardinal numbers, so on the observed correspondences between mathematics and the external world Renaissance Platonists founded speculations of a very far-reaching kind, intended to embrace not only the natural, but the intellectual and spiritual worlds. Nevertheless the chief appeal of their theories insofar as they were proposed as guides and criteria for scientific investigation, promising an immense simplification and unification of the view of the universe was, and perforcedly remained so throughout the Renaissance, as opposed to the practical or utilitarian inducements for their adoption which were still almost entirely hypothetical, largely "aesthetic." "C'est un fait curieux, mais indeniable," writes de Broglie, "que ce sentiment sert souvent de guide dans l'elaboration des theories de la philosophie naturelle...Une doctrine qui parvient d'un seul coup a realiser une vaste synthese en

montrant l'analogie profonde de phenomenes en apparence etrangers les uns aux autres produit incontestablement sur l'esprit du theoricien une impression de beaute et l'incline a croire qu'elle renferme une grade part de vertite. Il ne s'agit pas ici de la fameuse economie de pensee....Leur beaute [that of such theories] ne vient pas de ce qu'elle sont simples ou compendieuses mais de ce qu'elles nous revelent une harmonie cachee derriere la diversite des apparences, de ce qu'elles nous permettent de ramener la multiplicite des phenomenes a une sort d'unite organique."(281). In this respect the mathematician of the Renaissance, however theoretical, had the advantage over older "scientific" hypotheses. For in the case of colour, if qualities are the ultimate units revealed by analysis, diverse colours can the only be united by considering them as specific cases of some unimaginable, inaccessible and totally uninformative idea of Colour in general; to postulate on the other hand, that the qualitative differences in colours are but irrelevantly contrasting perceptual by-products (being wholly relative to the individual observer) of some purely numerical difference in some one common "stuff," characterised only by its being susceptible of sustaining such patterning, at once effects a more intelligible unification, offers at least a plausible illusion of explanation, and opens a path to experimental investigation (282). Such an interpretation of colours — as for example seen in the rainbow — the ancient atomists made, and Aristotle attempted to refute, attacking them for making the existence of the quality of colours dependent on the sight (and "sweetness" and "bitterness" on the taste etc.) (283). Thus Plato attributes to Protagoras in the Theaetetus the view that colours as appearance are produced by differing "motions" proceeding from variously modified objects impinging on the eye — and perhaps does not dispute the account as far as it goes; he later employs it himself in the Timaeus. For atomism and a mathematical neo-Platonism it was a naturally arising, firmly held view, that qualitative aspects of things were merely results of the character of the sense organ rather than intrinsic properties of things themselves; and as a dogma proved in various ways of great utility to science, long before Johannes Muller in the nineteenth century produced, probably the first, directly empirical, supporting evidence (284).

Dee believed that an abstract scheme could be correlated with the world of appearance, but he regarded this not as a mere fictional construction of the intellect, a scaffolding for thought and artificial device justified only as it led back to and assisted in effecting changes upon phenomena (285), but as a nearer approach to the ultimate realities of things, which lay concealed in the mathematical harmonies themselves. Today it may be necessary to admit opposing scientific theories, as, in practice, being only equally valid ways of ordering information, classifying and predicting experience (286) and to hold that formally "the plurality of equally cogent systems...dispels the indispensability in what is logically prior."(287) But such is a reflectively critical view rather than one which assists to creation, and probably arises only in the presence of several known working hypotheses, rather than at a time, as is the case with the sixteenth century, marked by the endeavour to achieve one at all. (The attitude that some thinkers adopted towards the Ptolemaic, Copernican and Tychonic cosmologies is a partial singular exception, and even so indicates rather the recognition of a supposedly temporary limitation of available evidence, than a positive philosophical position.) Moreover to those who embrace, or extensively work with, particular theories, they appear frequently to be something more than such a view would allow, and seem rather to provide ways of "seeing into" the universe, of showing by abstract concepts or symbolic analogy what things really are, and not merely how they behave. Such were their theories to the Renaissance neo-Platonic scientists. The Timaeus stated the fundamentals of their approach; sense perception involving contradictions and being entirely impermanent and in flux must, uninterpreted, spell only illusion; the true nature of the physical world could only be discovered by considering it as made up of mathematical, not experienced, intelligible not perceived, elements. To Kepler it seemed that the astonishing "harmonies" he discovered in the solar system could only mean that the mathematics of the universe were independent of it, bodies were subject to this mathematical scheme but it did not appear to be a material necessity of body itself (288). The special dangers of such a theory, practically speaking, and these account for many of Dee's mystical "aberrations," were that once it was accepted that all things could be adequately represented in numbers, a view increasingly justified in action, a natural implication seemed to be to reverse the application, and assert that number relationships when they accorded with no observed facts, still had ontological significance, were either themselves transcendental realities, or represented in essence sublime and celestial mysteries. Thus in the Republic it is urged that as all material things fall short of the truth — of which they are distant and imperfect imitations — and therefore also of the reality of number and geometrical figures, one should not employ, for example, mathematics merely to aid the science of astronomy (light brained astronomers who did this, studying the heavens only as phenomena, are reincarnated as birds in the Timaeus) but rather

the heavens should be taken as a model to aid man in the study of mathematics for spiritual purposes (289).

XII. Dee followed this teaching; he regarded mathematics as innate, or at least as exactly analogous to the faculties of the mind (290), and while asserting that a structure according with them was to be discovered in material things, which known, would give great power over the phenomena, he believed that this was less important than considering these last merely as examples of mathematical relationships which in turn were not limited, in extent, kind or significance by their material exemplification; and hence it is not surprising that Dee should seek religious meanings in the propositions of mathematics. He considered man, as many did in the sixteenth century, as being in the phrase Sir Thomas Browne probably found in Plotinus, "the great amphibian," (291) but the worlds man could move in were less "divided and distinguished than intimately conjoined. From Roger Bacon Dee imbibed much of his scientific attitude, and he followed too his insistence (the religious foundations of Bacon's thought, appear strikingly in his treatment of what Dee termed Archemaistry, and similarly regarded) that all knowledge was to be interpreted spiritually, or at least to be connected intrinsically with religious truth, since "Nichil enim est necessarium Christiano nisi propter anime salutem."(292) "Humane Artes" writes Nashe — one of Dee's apologists — "are the steppes and degrees Christ hath prescribed and assigned us to climbe up to heaven of Artes by which is divinity."(293) Moreover that very same Platonism which fostered and gave strength to the new science also denied the validity of a separation between religious and scientific knowledge. It asserted the correspondence of the hierarchies of existence and value. However mystical in content, neo-Platonic texts refused — as for instance the writings of the Pseudo Dionysius — to admit an opposition or even distinction between Reason and Faith. Again, the Timaeus overtly treats largely of physical questions, but it is impossible to separate those from the moral, or spiritual worlds which this cosmogony is designed to parallel. Thus in the Renaissance the least particular it was held was a manifestation of general law and through it something of universal significance might be perceived. But since such laws were separated from and set over and above material things exemplifying them, they appeared themselves, therefore, to be a revelation of the mind and purposes of God (294). Platonism thus was able to re-establish unity between the natural world and spiritual values which "Naturalism" frequently aimed at, but by employing the mediating concept of law, especially insofar as mathematics were employed in interpreting this, it largely avoided that fatal confusion that characterised purely "Naturalist" systems and encouraged scientific activity of an historically valuable kind. But not only did Platonic writings in general enter naturally into close connection with Christian teachings and appear more obviously compatible with them than those of Aristotelians; Averroes for instance denounced the system of Avicenna particularly for making too many concessions to the Motakallimin (orthodox theologians), but these "concessions" are Platonic elements in his thought, which happened also to be intrinsic parts of Mohammedanism, as they were also of Christianity, and which in turn contributed to Avicenna's popularity in the west; but Platonism had always traditionally been explicitly looked upon as chiefly religious in import, and sometimes acknowledged as almost a revelation. It is frequently represented as the final stage of thought preceding full acceptance of Christianity in the accounts of philosophical progress towards conversion in the early church. St. Hilary's affirmation "Perfecta scientia Deum scire" was also regarded as the argument of Platonism, for it was thus frequently summarised by even the pagan philosophers. Diogenes Laertius giving an account of what Plato meant by wisdom, says it is "the science which is concerned with God and the soul as separate from the body, and especially by wisdom he means philosophy, which is a craving for divine wisdom."(295) Justin Martyr, recounting his journeys through the schools, ending in Christianity, found its approximation among the Platonists, whom he joined in the hope of being taught by them how to see God, face to face, "for such is the end of the Philosophy of Plato."(296) It is an interpretation frequently advanced by Christian Platonists, even when chiefly preoccupied with science, in the sixteenth century. Thus Tymme, a translator of Dee, declares in the preface appended to his translation of Duchesne's Chemistry "Plato sayth, that Philosophy is the imitating of God, so far forth as man is able, that we may knowe God more and more, untill we behold him face to face in the kingdom of heaven. So that the scope of Philosophy, is to seeke to glorifye God in his wonderfull workes."(297) Again the Greek fathers had appealed to the Works of Plato (the 2nd, 6th and 18th epistles for instance) as anticipations of Christian doctrines, Augustine finds only two important dogmas omitted from Platonism, the incarnation — "the Logos made flesh that I found not there" — and the resurrection of the body (298). Plato and the Pythagoreans, claimed Clement, give evidence of real inspiration, and their utterances can be accepted like those of the prophets as true doctrines of God (299). Roger Bacon declares, on the authority of Augustine, that Plato, from his account of Creation must have read Genesis (300) and later, dealing with Moral Philosophy, solemnly recounts the legend that "in the tomb of Plato a statement written in golden letters was

found on his breast containing these words: I believe in Christ who will be born of a Virgin, will suffer for the human race and will rise again on the third day."(301) The works of non-Christian neo-Platonists, since they interpreted Plato in a semi-religious fashion also, influenced, or were found wholly acceptable to the Church as philosophical elucidations of its own dogma. Thus Proclus "more than anyone else provided theologians with an intellectual framework for its view of the World, and Christian mystics with a defence of the way of negation."(302) Similarly in the Renaissance de Mornay in his work on The Trueness of the Christian Religion draws heavily on Plato, his followers and the hermetic texts in his demonstration, but remarks after a lengthy exposition of the views of Plotinus "The Aristotelians have no voyce here because they stand all in commenting upon Aristotle, who gave himself more to the liberall Artes and the searching of Nature, than to looking up to God the maker of all thinges."(303)

In the sixteenth century religion and the philosophical groundwork of the new science were still closely intertwined. If metaphysics and experimental investigations were set on independent and perhaps divergent paths, it was hardly as yet apparent. Later ages might find more freedom and advantage in an attitude of mind reminiscent of that which defended the Averroist "double truth," and might separate Religion and Science (Boyle in the Christian Virtuoso is already attempting to delimit the spheres of legitimate speculation within each) into two independent, corporate, systems of knowledge, so that these no longer touched and merged at every point, and if they were not entirely inaccessible, one from the other, the transition could be acceptably effected only along a limited number, and particular types of thoroughfares. The seventeenth century scientific legatees of the Renaissance, secure in the possession of a now unquestioned method that presented "facts" in a manageable and uniform fashion, could confidently declare with Myson, and feel this to be the key to the material progress, and continuous advance in knowledge, stretching ahead, of which they felt clear promise, that man "should not investigate facts by the light of arguments but arguments by the light of facts, for the facts were not put together to fit the arguments but the arguments to fit the facts."(304) They could, now that the philosophical battle to establish the validity and importance of mathematics for natural sciences was won, proclaim the result, which was no longer questioned to be obvious to mere inspection, and might even, for example, affirm with satisfaction as an adequate account of its basis, an empirical origin and justification for geometry (305). It became quite common in this age to claim to value mathematics only insofar as it was of direct utility, now that its applications had proved so extensively successful, or even to denigrate it as a pure science compared with the mechanics to which it had itself given birth (306). But in the preceding centuries, though the belief in a unified tradition of generally comprehensive truth which the presence of a single universal in the world had seemed to provide was failing, yet the feeling which such a tradition had fostered, that some coherent framework existed that would do full justice to all the powers of man's soul as well as adequately "explaining" all natural phenomena, still dominated thought. Though the solutions were not to be identified with any previously fully enunciated doctrine, there still remained the exhilarating faith that man was capable of creating, or discovering such a general synthesis. Dee's mathematical Platonism was an endeavour towards such an ideal. Certainty and Truth were to be found in an intellectual world, attainable by reason, if unknown to the sense. The position that man's mind was granted in the general scheme of things seemed to imply the reasonableness of nature, and the safe use of intelligibility as a valid criterion of reality (307). But the nature of God and of the soul were intrinsically bound up in this picture, for the sixteenth century was not hardy enough, or so blinded by success, to be able to be merely content with the unqualified mathematical materialism, inherent in its method, with its unsatisfactory almost contradictory consequences, which dismissing too much of the world as "unreal" or as "appearance" still eft these aspects of it (irrelevant of course to its more immediate purposes as they were) as an intolerable problem from any other standpoint (308). For though to thinkers such as Dee, these qualitative aspects of the world derived, in one sense, their reality from abstract elements of a different order from themselves, figuring in intellectual analysis, yet they were also effects on the soul, itself supremely real, and to Dee indeed something subsisting properly above the purely "intellectual" realm, and were therefore not irrelevant "accidents" but possessed of meaning and value. Thus it has been said of the impression the Timaeus produced on this age, "It was precisely this fusion of the rational-mathematical, the aesthetic and religious elements in the contemplation of the universe, this glorification of the Cosmos, that appealed to the philosophers of the Renaissance."(309) Mechanism and the search for metaphysical truths or religious devotion went hand in hand connected by a neo-Platonic evaluation of the significance of numerical harmonies.(310) The end held out by this philosophy, conceived as identical with that of science or religion, was a vision "of the rational beauty of the Universe," (311) which in its all-inclusiveness had a place for every type

of speculation and experience — mystical, logical, empirical — authorising and guiding each; and the full acceptance of which, as an exhaustive account of reality, would not threaten to stunt man, intellectually, morally or spiritually, and would admit as totally true nothing less than what was entirely adequate to satisfy the maximum potentialities of man in all the various aspects of his complex, though essentially unified nature.