CHAPTER III

EARLY STUDIES — PARTICULAR FIELDS OF INTEREST AND CONTEMPORARY THOUGHT (1527-1548)

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XIII. Mechanics. The application of mathematics. Dee and utility — his views on demonstration and intuition — the rational and its empirical exemplification — the influence of Archimedes.

XIV. Conclusion. Dee's attitude to knowledge — secrecy and an aristocracy of learning — yet advocacy of popular education — mathematics central to his thought — nature to be studied quantitatively — but no clear cut boundary between the physical and the spiritual — metaphysics essential to his attempt to prove mathematics adequated to the dignity of man's soul.

I. Owing to the contemporary interest in the casting of nativities we are in possession of more exact information as to the date of Dee's birth than of many other more important events in his life (1). It occurred at eleven minutes past four in the afternoon of July 13th 1527 in London (2). Of his father Rowland Dee little is known except that he was a Gentleman Sewer in the service of Henry VIII, who owing to some unexpected misfortune, or injustice, was unable on his death to leave his son a competence (3). Dee's mother (4), who survived into old age would seem to have outlived her husband by many years; and Dee's house at Mortlake was long in her name. The family seems to have been part of the Welsh "invasion" that followed Henry VII's accession and remaining connections in that country appear later to have been of assistance to Dee in forming his collection of Welsh records, and other manuscripts and antiquities--he himself is later to be found associated with contemporary works on the Welsh language. The family had certainly once been of some prominence and, in a genealogical table, deriving the Tudor dynasty from the ancient British Kings, Dee claims for himself a distant blood relationship to Elizabeth (5). He received his early education in London and at the Chelmsford Chantry School, and proceeded--"meteley well furnished with understanding of the Latin tongue," (6) still not invariably the case before arrival at the University--in November 1542 to St. John's College, Cambridge.

II. At this time the Universities were in a state of change, comparative disorganisation and confusion. Royal injunctions of 1535 following the execution of Fisher, Chancellor of Cambridge, for refusal of the oath of supremacy, had commanded changes in the curricula without however any directives as to their implementation. Entries of students in the decade ending 1547 are the lowest ever recorded. They hardly exceeded 30 at Cambridge, and were only 20 at Oxford in 1545. The Injunctions had forbidden lectures on the Sentences of Peter Lombard, and on the common law. The scriptures were to be read and all divinity lectures were to be upon them "according to the true sense thereof and not after the manner of Scotus." Colleges were to provide two daily public lectures, one of Greek and one of Latin. Students in Arts were to be taught logic, rhetoric, arithmetic, geography, music and philosophy, and to read Aristotle, Rodolphus, Agricola, Melancthon, Trapenzuntius "and not the frivolous questions and obscure glosses of Scotus, Burleus, Anthony Trombet, Bricot, Bruliferius etc."(7) Some improvement in the standards of instruction--which had declined with the falling off in numbers among the scholars, and for other causes produced by Henry's religious policy--was projected by the establishment of the five Regius Professors of Divinity, Civil Law, Physic, Hebrew and Greek in 1540, which was designed to effect a transfer of the higher instruction of students from the administratively overworked, frequently ill-qualified and now low fee'd regents of the faculties to the specialist professors. Nevertheless despite such changes, the old pattern of the trivium, and quadrivium seems still to have remained dominant, as it had been from the twelfth and was in large to be until the end of the sixteenth century. This had originally required four years of study from a student on grammar, rhetoric, and logic for the degree of bachelor, followed, for the degree of master, by three years devoted to numbers absolute (arithmetic), numbers applied (music), magnitudes at rest (geometry) and magnitudes in motion (astronomy). As, however, almost the only test of a student's knowledge of the subjects of the quadrivium was his own declaration to that effect, they seem in practice to have been left largely unread by most bachelors. Dee took full advantage of what the University could offer in this respect, even obtaining permission to supplement his studies, before his mastership, with a period at Louvain, where he first made the acquaintance of a number of prominent continental mathematicians. But there was little formal instruction of any value at the universities in mathematics, and as a science its development proceeded throughout the century with the assistance of the enthusiasm of individuals, or small groups, and the growing technical and commercial demands on it. For a long period the study of the subjects of the quadrivium had been confined to the range of materials to be found in Boethius, Cassiodorus and Isidore. A Renaissance had commenced in the fourteenth century when Paris University in 1330, soon followed by many other European universities, had introduced new textbooks, such as Euclid Sacrobosco, and Witelo's optics. The revival had been short lived; lecture lists of Bologna, Padua and Pisa in the fifteenth century show astrology as the only mathematical subject taught. Instruction in Oxford at the same
period was confined to Ptolemy's Astronomy and the first two books of Euclid. Wolsey had founded a mathematical lectureship (as well as six on other subjects) which the Bavarian Nicholas Kratzer held for a few years, but was the first and only person to do so since the lectureship lapsed on Wolsey's fall, and was not among those later re-established by Henry VIII. Similarly in Cambridge, a few years before Dee's arrival there (1535) the Barnaby lectureship on mathematics had been suspended, so that the stipend of L4 could be diverted to lectures on Greek and Hebrew (8). The situation in this respect, was improving at Paris under the influence of Ramus and Finaeus, but it was to the newer universities of Germany, that the sixteenth century mathematicians chiefly looked as the principal academic centres for the encouragement of this study. In England the Edwardian reforms were swept away soon after Mary's accession (9), the readership in mathematics at Oxford, offered to Dee in 1554 (and on his declining it the scheme seems to have been abandoned) was perhaps one of the last vestiges of these.

However, in contract with Oxford, which showed itself much more uniformly hostile, and resistant to contemporary changes, and where, in general, instruction was still largely dominated by a conservative, more narrowly philosophical bias, Cambridge emphasised rather letters and the sciences and afforded considerably more facilities for the type of study towards which lay Dee's particular bent. Its leaders were the spiritual successors of a generation of English humanists and

Reformers who had evolved a loose and eclectic Platonism from many sources; men such as Grocyn, Colet, More, Linacre, Latimer, Lily; a group who had welcomed Erasmus, and also, let it not be forgotten, Cornelius Agrippa. Thus in the sixteenth century many whose interests lay particularly towards mathematics are to be observed migrating from Oxford to Cambridge; Tonstall had been one of the first of these, Recorde, who had held an Oxford fellowship in 1531 had also done this, taking a degree in medicine at Cambridge in 1545 (it is possible indeed that the beginning of Dee's friendship with him dates back to the time when they were both in residence there). Several of Dee's contemporaries at Cambridge made names in similar fields to those he chose particularly to explore; Cunningham (whose Cosmographical Glasse, 1559, shares its title page with Dee's Euclid) came up in 1548, Blundeville, who was to produce the first work in English employing plane trigonometry, may also have been there at this time, and Dee's future collaborator Billingsley entered St. Johns in 1551, only three years after Dee's own departure. Encouragement was given to such students by Sir Thomas Smith, Professor of Civil Law, whom Gabriel Harvey was to declare as greater than Ptolemy, and Sir John Cheke, Professor of Greek (who, together with Ascham--another scholar and educational reformer with whom Dee was personally associated (10) and who was at this time a fellow of John's--is described as placing pagan literature next to the Bible), for Cheke tried to encourage scientific almost equally with humanistic studies, and despite the criticism of those who regarded these subjects as unworthy of serious attention, he "feared the blame of a mathematical head so little in himself, and thought the profession to be so far from any such taunt....as he betrayed in his great affection towards them (mathematicians) most evidently in this is doing."(11) Dee probably became one of the group of Cheke's "young men"; he owed to him his introduction to Edward VI, and perhaps also the beginnings of his acquaintanceship with Cecil, who had married Cheke's sister in 1541.

III. At Cambridge Dee gave himself up to study "quasi sacro voto obligatus."(12) His own account of his assiduity is well known: "I was so vehemently bent to studie, that for those years I did inviolably keepe this order; only to sleepe four houres every night; to allow to meate and drink (and some refreshing after) two houres every day; and of the other eighteen houres all (except the time of going to and being at divine service) was spent in my studies and learning."(13) The fervour which attends all Dee's descriptions of his zeal to learning, and the expectations he often envisages as promised by the vast scores of information rapidly becoming available to the age, recall the enthusiasm, expressed in Gargantua's letter to Panta rue at Paris, written only a few years before Dee came up to Cambridge: "Now it is that....the old sciences are revived which for many ages were extinct. Now it is, that the learned languages are to their pristine purity restored viz: Greek, without which a man may be ashamed to count himself a scholar, Hebrew, Arabic, Chaldean and Latin. Printing likewise is now in use so elegant and correct, that better cannot be imagined....All the world is full of knowing men, of most learned schoolmasters, and vast libraries; and it appears to me as a truth that neither in Plato's time, nor Cicero's, nor Papinian's, was there ever such conveniency for studying, as we see at this day there is."(14) It may be noted that the kind of study, for which Dee hailed the age as so promising, and from which so much was to be expected was not of a type he seems to have felt could be then best pursued in the great centres of formal academic instruction; in later life he kept very much apart from the English universities.

After receiving his B.A. Dee became, in 1546, one of the foundation fellows of Trinity, and probably through Cheke's influence under-reader in Greek, an appointment his mathematical accomplishments may well have been as instrumental in securing him as any expertness in that tongue (15). However, he "set forth" The Peace of Aristophanes, when his mechanical device of the flying "Scarabaeus" which carried a man with a basket of victuals up to the top of Trinity hall, produced much amazement and gave to the credulous or malicious-tongued opportunity to make free, perhaps for the first of the many times he was to suffer the like afterwards, with the word "conjuring." Such charges, generally, were unfortunately encouraged by the misconceptions that could all too easily arise from the somewhat ambiguous terms, in which scientists then described their own activities. Thus Dee employs "Thaumaturgike" as a generic description embracing such feats as this, it was the art that was conversant with the principles, and practised in the construction of all types of machines — those such as Hero described, or such as Archimedes, Boethius and Regiomontanus built (16). Similarly Agrippa, and not unusually, classifies as a special branch of "magic," all mechanical effects designed with the aid of mathematics (17). Dee on this occasion probably utilised descriptions of stage machinery, from Bk.V of Vitruvius and the Onomasticon of Pollux. Miss L.B. Campbell comments on Dee's device: "the fact that Scaliger, writing of the used in comedy after the fashion of the machine by which in tragedy the deus ex machina came upon the scene, added to the description of Pollux the remark, "qualis Cantharus sive Scarabaeus Aristophanes" makes it clear that this experiment by Dee was in the nature of an attempt to follow classical tradition."(18)

Another incident is chiefly remarkable in that Dee should have felt fifty years later that it was worthy of record, and inserted it proudly, among many apparently more notable feats, in his "Compendious Rehearsall" — drawn up to display his merit and talents, his valuable past achievements and to suggest the still greater scholastic and mechanical exploits that might be expected, were adequate financial support forthcoming. The explanation for its appearance there may well be found in the almost talismanic effect the concept "Emperor" seemed to have for Dee in later years: he wished Elizabeth to assume the title and Britain to become an "Empire" that should dominate the globe. (His repeated efforts and suggestions in this direction met with no success and there are indications that his later continental voyagings represent, in one aspect, a pursuit of the "Empire Ideal" into wider fields.) He writes then, forty-five years afterwards, of his time at Trinity, "In that Colledge also (by my advise and by my endeavours, divers waies used with all the other Colledges) was their Christmas Magistrate first named and confirmed an Emperor."(19)

In May 1547 Dee began a journey through the Low Countries "to speak and conferr with some learned men, and chiefely mathematicians, as Gemma Frisius, Gerardus Mercator, Gaspar a Mirica, Antonius Gogara" (20) and returned a few months later with two great globes of

Mercator's making, and an astronomers' staff and armillary ring of brass of a type newly invented, or improved, by Gemma Frisius, which he presented to the fellows of Trinity. He received his M.A. unusually quickly, in 1548 (21) ("and never after that was I any more studient in Cambridge"(22)); and then set out again for Louvain where Gemma Frisius (1508-1565; M.A. Louvain 1528, where he resided thereafter) was teaching geography, mathematics, astronomy, and medicine. Dee's reasons were probably identical with those he later set forth to Cecil when asking for permission to remain abroad and print his books in Germany (23)--that England offered neither adequate encouragement, associates, nor instructors in the pursuit of mathematical knowledge: "Albeit that our universities both, in them have Men in sundrye Knowledges right excellent as in Divinitie, the hebrue, greke, and Latin tung etc. Yet, for as much as the Wisdom Infinite of our creator is braunched into Manifold worts of Wonderfull Sciences greatly aiding Dyvine Sights to the better view of his power and Goodness, wherein our cuntry hath no man (that I ever yet could here of) hable to set furth his fote or shew his hand, as in the Science De Numeris formalibus, the Science De Ponderibus mysticis, and ye Science de Mensuria divinis; (by which three, the huge frame of the world is fashioned, compact, rered, stablished and preserved) and in other Sciences, eyther with these Collateral, or from them derived, or to themwards greatly us fordering." The period may be loose and involved but Dee's purposes and the particular preoccupations of his mind are quite plain.

At Cambridge rumours had been started by his stage machine, and already it is possible that a mysterious obscurity, suggesting his adeptness in, it could not be known quite what, esoteric profundities, may already have begin to envelop his activities, and make him a legend there (24). Smith considers that Dee's spiritual ruin is traceable back even to this period, and exhibits him as a Faust figure led by overweening desire for learning to peer beyond the bounds of legitimate Knowledge: "Ab hoc enim tempore (1548) mihi perquam verisimile videtur, Devam spes vanas in animo aluisse, licet sub specioso puram veritatem & Thesauros Coelestis sapientiae investigandi praetextu, se tandem aliquando, quod mortalibus vixdatur assequi, assecuturm, & inde ex studio Mathematicarum Scientiarum, Physicae et Chymicae, in arcana naturae, & rerum tum naturalium tum diviniarum profundiora penetrandi, & novam, eamque plane mysticam, Philosophiam, quasi vilesceret & omnino repudianda esset, quae tunc usu communi obtinuerat, introducendi, & denique sibi ipsi ex indulgentia vanissime & prorsus damnandae curiositatis insignem apud omnes formam adsciscendi ardorem crevisse; cujus propositi impietatem sub plausibili Scientiarum Mathematicarum praetextu, tanquam sub speciosis involucriz, a quorumvis conspectu occulere voluit."(25) It is perhaps possible to arrive at a more exact picture of Dee's speculations and interest; it involves a certain amount of anticipation but his writings tend to show that although different topics dominated his attention at various periods he altered his general theories remarkably little, and in essence these seem to have been early framed; while some wider survey of a few of his early fields of study may serve as a useful preliminary to later notices of Dee's own works, in which much of their foundations exists only implicitly, as submerged assumption.

IV. Up to this time Dee claims to have composed two books (26) which, like the greater part of his works remained unpublished, and like so many of his manuscripts now appear to be lost irrecoverably. He gives their titles as The Art of Logicke, in English (1547), and The 13 Sophisticall Fallacies, with their Discoveries, written in English meter (1548). That Dee should elect to write these in the vernacular perhaps indicates how early he had adopted the opinion that all branches of useful knowledge ought to be made as widely available as possible, translated into forms in which the relatively unlettered, possessing no tongues or university education could comprehend and from which they might, in effect, teach themselves. But it is also perhaps not irrelevant that such works on logic as were to appear in English in Dee's age, addressed to a similar public and composed with similar purpose as were for instance the Recorde/Dee arithmetic, and the Dee/Billingsley geometry, were frequently of a pronouncedly "Ramist" cast, perhaps as a consequence of the association of such productions with the religious reform, or puritan, movements in which circles Ramus enjoyed his most extensive popularity. The fallacies Dee treated of, it is clear from their number, were the standard list of thirteen taken from Aristotle's De Sophisticis Elenchis, but this does not at all imply any general adherence on his part to Aristotelian methods. The list was an accepted common place and one does not encounter any criticisms of the value of this negative or purely clarificatory aspect of Aristotle's thought. The conclusion of The Arts of Logicke, written at the end of the century by Dee's friend and admirer, Blundeville, who wrote mainly on navigation and applied mathematics, is for instance an extensive treatment of fallacies exactly as they were first discriminated and classified by Aristotle (though no acknowledgment to him is there made), while in other respects, though the influence of Ramus is also clearly perceptible, Blundeville professes his acceptance of the teachings of Acontius — another friend of Dee, and one not dissimilar to him in his interest in mathematics and mechanics, nor perhaps also in his advanced religious speculations (27).

Whether or no these works of Dee were affected by Ramist doctrines — and chronologically this is quite possible since Ramus had defended his thesis against Aristotle in 1535 and in 1543 had appeared both the Aristoteliae Animadversiones and the Dialecticae Partitiones sive Institutiones (reprinted 1547, 1549, 1552, etc.)--of Dee's later interest in these and of their congeniality with his own philosophy there can be no doubt. Dee states that he commenced his studies at Cambridge with logic, but there is little discussion of it directly in his later writings, though he makes some criticisms, as in the notes to Euclid, of those who fall inevitably into error by attempting to practise it without a previous study of mathematics. He is pleased when he can display mathematics as a corrective to the errors, produced by the uncontrolled use of synthetic qualitative concepts in the verbal arguments of the schools (28). His passages on logical method in the Euclid perhaps naturally, make no mention of the syllogism but his praise there of the Euclidean resolutive-compositive method which he ascribes to Plato, and wishes to see transformed into a universal instrument of enquiry and demonstration — may be paralleled by very similar passages in Ramus' writings (29). Dee enjoyed the friendship of Ramus' teacher Orontius; he sought out Ramus' acquaintance in Paris in 1550 (30); his friendship with him is mentioned by some of Ramus' biographers (31); and he corresponded with him about surviving MSS of Greek mathematical texts (32). Dee's library moreover contained a notably large collection of Ramus' works and those of his followers, while Ramus' views were rapidly propagated in England, and chiefly by those who may be grouped with Dee as exhibiting similar intellectual tendencies or with whom he had known personal associations. Ascham had introduced the Ramist teachings in Dee's time to Cambridge, which was later to become a recognised stronghold of the doctrines, drawing to it students from abroad, who wished to learn Ramist logic and philosophy. A pupil and intimate of Ascham's, Thomas Wilson, published his Rule of Reason, an English version of the logic in 1551. (Sir Thomas Smith's copy of this, heavily underlined and annotated, is preserved in the British Museum.) It came from the press of Edward Grafton who had many connections with the progressive Protestant party in England at this time, was printer to Edward VI and associated with the production of the English Bible. Ramus' popularity was great among the humanists, the upholders of the new learning, and educational reformers (33), and it increased in England through the century; Sydney, whom Dee tutored in Mathematics, was an admiring student of the Ramist logic, and his secretary Sir William Temple, later provost of Trinity College Dublin, who produced

an edition of it in 1584, was one of its chief advocates. Ramus' protestantism was not without effect in assisting the spread of his influence in England; Chamber in 1574 calls him one "que omnes amare meritissimo pro eius eximia sanctitate debemus."(34) Ramist teachings moreover appear to have been particularly taken up by those who were especially concerned with mathematics. Ramus had attempted a reform of the quadrivium (Recorde's work has been associated with him in this respect (35)); of geometry and mechanics indeed he once wrote to Dee's friend the engineer Acontius "iis enim studiis modo totus deditus sum" (36), he founded the first chair of mathematics at Paris, and adopted the position that only in them was to be found absolute certainty, all else being therefore matter for discussion rather than strictly demonstrable (the premiss here was of course even then a platitude, the application of the consequence to an examination of the proper function and potentialities of verbal logic was not, and plays an important part in Ramus' thought); and though his direct influence on the methods of teaching geometry was ultimately pernicious, as an encourager of this study he was highly valued. Commandine, with whom Dee collaborated in a work on geometry, in his translations of the Elements invokes Ramus' authority for the judgment that those who neglect or do not utterly trust mathematics can be no better than Epicureans or followers of Aristippus (37); Ramus himself in his edition of Euclid asserts that nothing in the world can be more varied and multifarious than number, refers his readers to the Platonists and Pythagoreans for a proper appreciation of mathematics, and cites authority and arguments--though without firmly committing himself to them--tending to show that it must derive from reminiscence, since it is not possible to believe such a science to be an invention of man (38).

Recently an extremely unfavourable examination of Ramus' thought, particularly of his logical method, has been made by N.E. Nelson (39), who states that "a period in which such a farrage of a priori nonsence could be taken seriously by intellectual leaders must have been an era of amateurs dabbling in problems which they did not clearly comprehend." Ramus, it is said, "tried to derive his system from the processes of thought without enquiring how the elements of thought are related to experience and reality," "he does not show himself conscious of epistemological problems and does not explicitly deny Aristotle's solutions" his logic is "only a rhetoric for ordering arguments persuasively," "a thinned out manual of eristic" drawn almost entirely from Quintilian (40) and Cicero. But it is possible to accept both the detailed observations made by Nelson, and also even his total judgment of the absolute value of Ramus' system considered in itself, without in the least impugning its historical importance and significance. For in one sense Ramus' work is less a single permanent achievement than in its rapid popularity, a symptom, exhibiting very revealing characteristics, of the fermentation of the new thought of the age. The problems it claimed to resolve may not have been clearly comprehended, but they are nevertheless new problems, or posed in a new form, and important in that they should have been felt to demand an answer. It was designed to assist a reform in scientific method, to which it certainly contributed, if not directly by any constructive assistance it offered to investigations, as a system, yet by the extent to which hampering impediments and inconveniences which the Aristotelian philosophy revealed when applied to such purposes could be dispensed with, were Ramus' position adopted. If Ramus did not deal with epistemology specifically in his writing, his work is none the less not without some importance in this respect, and the acceptance of his system implicitly involved, and would lead inevitably to the denial of certain features in Aristotle's account of knowledge; for it represents a genuine attempt to grapple with problems of meaning, to free logic from slavery to forms of language — the syllogism is belittled as being merely a means to clarify propositions — and to produce a constructive form of thought, which should, above all else, be valuable as an instrument of discovery. It is rhetorical in one sense since its dialectical method aims in its particular applications at a conviction which is to be generated in the mind, rather than a mere assent imposed on the judgment by the form of words, and its acceptance of this ideal entails (as do many of the Socratic dialogues which treating limited questions seem at first sight to rely merely on persuasive methods, to employ solely arguments ad hominem), the need for a Platonic view of mind for its full philosophical justification. Logic, Ramus claims, makes explicit what is natural to the intellect; thus the rule of universal nature and logic are one, and inseparable (41). But his own logic is less important for its positive method of universal

dichotomy (which also recalls the procedure of the ancient academy) than for its rejection of the Aristotelian substance — accident analysis of reality. Aristotle had insisted that knowledge must be based on definitions of things; and in order that a thing might be defined it must exist per se, and not on account of an attribute it possesses. Arguing against those who maintain that an entity can only be described by enumerating all its accidents, he declares that "they are compelled to assert that all things are accidents" "and since the accidental always implies a predication about some subject, if all statements are accidental there will be nothing primary about which they are made so the predication will proceed to infinity."(42) This position, Aristotle makes it clear, he feels to be a reductio ad absurdum. Ramus leaves such objections unanswered; but the system he substitutes for the Aristotelian logic developed from this assumption of the necessity for an initial determination of the absolute and immutable essences of all objects considered, implies that the synthetic concepts used in this or any other analysis of reality have only relative not absolute validity and merely a pragmatical or psychological foundation. Essence and accident he reduces to a common level. The categories, predicables, predicaments are swept aside, and the single term "arguments" is made to cover them all. The "argument" is "whatever is affected to the arguing of something else," every word has reference to an indefinite number of them, and they in turn are what make that word intelligible. The thoroughgoing "relationism" of such a system, its own freedom from dogmatism and its flexibility was a useful framework for novel speculation, and proved especially compatible with the needs of the new science in so far as this desired additional defence of its claims that in viewing nature mathematically it was arriving at more important truths, a more fundamental aspect of nature than Aristotelianism would allow could be attained by adopting such a method. The degree of Dee's own adherence to the Ramist teachings remains of course entirely conjectural, though of his interest in, and familiarity with, them there is no doubt. Those who gave them their support were frequently those who can be associated with neo-Platonic thought, however, and it is possible that his own acceptance of them or at least their prevalence at the time contributed something to the confidence Dee shows in arguing from general assumptions which might be directly contradicted from an Aristotelian position (by-passed, as it were, by Ramism); a confidence shown in so far as he does not evidence any feelings of a need to make a defence of such assumptions, or counter the orthodox objections.

V. But if Dee's attentions to logic found little explicit expression or unequivocal reflection in his later works, another study--astrology--that he had embarked on at this period was thereafter to occupy a prominent place in both his physical theories and more "mystical" speculations. It was in 1547, he writes, that "I began to make observation (very many to the houre and minute) of the heavenly influences and operations actuall in this elementall portion of the world."(43) While at Louvain he was encouraged in this study by Mercator and Gogava, and it was "certaine earnest disputacions" of theirs which led him eventually to compose the Aphorisms (printed 1558) (44), which he recommends in the Preface as the most compendious treatment of the basis of this science. The copy of the Quadripartitum he possessed at this time still survives: he has heavily underlined and marginally annotated almost every page. "Solus Ptolemaeus verus ex omnibus astrologis," he exclaims at one point (45), and notes approvingly the claim of Egidius in the prefatory epistle, that no knowledge can be higher than that of the stars and astrology, since their principles comprehend the whole natural operations of the World. Dee's primary concern with astrology seems always to have been directed rather to the philosophical or cosmological implications that might be derived from it if some correct knowledge were ascertainable as to the manner and principles of its general operation, than towards immediate "judicial" practice. He drew up large numbers of horoscopes of his family and acquaintances, but perhaps largely as a matter of custom, or possibly experimentally (his figures are seldom accompanied by detailed verbal interpretations necessary if they were to be utilised other than privately), for he wished always to refound the science inductively on observed correlations. He was compelled at times to draw up formal, full-length nativities for his patrons, but would seem always to have been himself cautious and suspicious of the amount of tradition and unverified conjecture that entered into such detailed forecasts; a hint of personal disassociation with the results thus obtained, appears for instance in his record of how "Before her Majesties (Elizabeth's) coronacion I wrote at large, and delivered it for her Majesties use by commandment of the Lord Robert, after Earle of Leicester, what in my judgment the ancient astrologers would determine of the election day of such a tyme, as was appointed for her Majestie to be crowned in."(46) Dee made later, in the Preface, a reasoned and moderate defence of astrology and its legitimate sphere of application, based on its harmony with accepted cosmological theory, and on the argument that its effects could be interpreted as due to natural, wholly physical causes, and were not beyond the possibility of verification. It is interesting that various vitriolic attacks on "astrology" end with a partial retraction, a careful qualifying of their position, and affairs an adherence to a similar or even to the same view as urged here by Dee (47).

Astrology and Astronomy were much more clearly distinguished by practitioners of them such as Dee, than by the opponents of astrology. Those who rejected the one were frequently such as despised or could see no purpose in the other. "To what end" demanded one such enemy of "superstition," "hath God placed us so far from the stars if with astrolabes, staves and quadrants we can do all things as if we were nearer."(48) They were nonetheless closely allied sciences, and this not only for the social reason apparent in Kepler's observation that mother astronomy would starve if daughter astrology did not support them both. Astrology, by linking the descriptive data of astronomy with the physical world additionally justified the study of the former, provided powerful incentives towards increasing accuracy and diligence in observations of the stellar and planetary motions, and moreover offered a framework of "scientific" theory--i.e., of theory ordered, coherent and pregnant in suggestion for further investigations — of considerable generality and imaginative appeal, at a time when the discovery of some such reasonably satisfactory universal scheme was, for many perhaps, psychologically indispensable as a preliminary to the undistracted pursuit of more detailed and ultimately more valuable, researches. Whatever its superficial abuses, its potential value seemed almost limitless to many in the Renaissance; for astrology, it has been pointed out, "offering as it did, a reasoned explanation of an infinite diversity of physical phenomena, and including in its scope psychology and ethics, made possible even in the Middle Ages dreams of a universal science."(49) What astrology traditionally laid chief stress on was moreover what the new science aimed at discovering — the unity, orderliness, and inter-connectedness of the cosmos. Some astrologers, such as Manilius, had believed this integration to maintain so completely that they were led to affirm the universe was

a single "animal."(50) But passages in the Renaissance tending, seemingly, to ascribe "life" to the stars are often of more ambiguous import. Thus, when Dee, or natural philosophers such as his friend Mizaldus, speak not only of the harmony existing between the bodies of the stars, sun and planets and those of men, but also between their respective "spirits," and of the sympathies and similarities between stellar effluxions and affections and faculties of the soul, it is necessary to remember that such thinkers frequently did not set up a sharp dualism between spirit and matter, but imagined an infinite gradation to subsist between the pure spirituality of god and pure corporeality — vital spirits, even parts of the "soul" might well be "ethereal" but corporeal — and it was thus possible to allow a degree of animation to the stars without embracing pantheism or even regarding them as individual consciousnesses, and to allow to many so-called "spiritual" phenomena a degree of corporeality without adopting a merely mechanical materialism.

Thus Dee underlines Milichius' editorial comment on Pliny's description of the stars as animated (51): "Et quan corpora coelestia non sunt organica que admodum terrena animalicum corpora, tamen no video quid prohibeat quo minus animalia dicantur, illa videlicet anima quo suo mo illig corpora mouet ac format!" The assumption of such a hierarchy was almost a necessary belief for philosophers thinking in neo-Platonic terms — it is reflected in the pan-psychism of Telesio, Bruno, Campanella, for instance — but it was far more widely current. The concept of the Great Chain of Being — which led to a similar cosmological pattern — was possessed of a seemingly independent vitality. Certain cabalistic and other magical practices, for their supposed efficacy were often defended by telekinetic theories, and ascribed to the imaginative force acting at a distance, similarly implied it. Such effects as evidenced by magnetism were interpreted — Gilbert provides a typical and well-known instance — as rather approaching the category of spiritual than physical phenomena, and indeed recourse to such a postulate seemed necessary for the full explanatory description of a multitude of observed events. Thus in the absence of any adequate celestial dynamic, Kepler was led to suggest that the earth enjoyed vision and memory to guide its course among the stars (52). The world soul, a prominent dogma in early neo-Platonism and partially Christianised by such fathers as Origen, and Cyril, and by Simplicus (53) very often fulfilled a useful role in explaining the supposed presence and permanence of universal laws, of which the existence was a necessary initial postulate for much Renaissance scientific effort; though it is significant that such a complete distinction as Cudworth was able to maintain between the classes of soul and matter, and their respective actions, lies latent in the approach of earlier neo_Platonic mathematicists and emerges gradually as their favoured methodology was able to fuse more completely with increasingly extensive portions of the external world.

VI. There were remarkably few who were prepared to reject astrology outright (54) (even Francis Bacon, who considered that "At astrologia multa superstitione referta est, ut vix aliquid sanum in ea reperiatur," declares "Attamen eam potius expurgandum, quam prorsus abjiciendam esse censemus"(55)) and this not only for the golden promises for the satisfaction of curiosity it held out, or the practical services it would do, could any part of it be proved, or the collateral benefits it brought to other more "reputable" if less ambitious or utilitarian studies, but because astrology in many respects seemed a well-founded physical science. Especially was this so in regard to "meteorology," a sphere in which even Sextus Empiricus had found nothing in its practise to quarrel with (56), and in which James I, otherwise uniformly hostile to astrology, was still to concede its practice as legitimate (57). The effects of the light and heat of the sun on terrestrial phenomena, and the influence of the moon on the tides seemed to be observational verities, and these not radically different in kind or more improbable than other effects conventionally attributed to the heavens by astrology. (Thus Galileo derided Kepler's belief that the moon could be regarded as a causal agent in the production of tides, since he felt compelled to place it in the category of "astrological nonsense" (58)) and it appeared reasonable that the other celestial bodies performed similar functions, and there were not wanting those who claimed to provide far more extensive empirical supporting evidence (59). Belief was reinforced by the familiar doctrine of the superior dignity possessed by the heavens over the elemental world (accepted equally by an Aristotelianism affirming their quintessential constitution, or a Platonism making much of the Epinomis) in the hierarchy of creation, and the theory of the "natural" order of things which implied the rule of the higher over the lower. Tycho Brahe in his oration in 1574 de disciplinis mathematicis, which has many points of similarity to Dee's Preface of four years before, exclaims "Non dubium est enim hunc inferiorem mundum a superiori regi et impregnari:

O quam mira at magna potentia coeli est
Quo sine nil pareret tellus, nil gigneret aequor." (60)

Roger Bacon, whose writings exercised a persuasive influence on Dee's thought, also uses this argument, applying it significantly to demonstrate the fundamental importance of mathematics — "Nor are inferior things known except through superior ones because the Heavenly bodies are the Causes of things that are lower. But the Heavenly bodies are known only through quantity as is seen from Astronomy."(61) Moreover Astrologers could claim support for their theories of the causal efficacy of the stars, from the writings of Aristotle, who had for example in a passage cited by Dee in the Preface, along with similar ones on the same subject ("His Meteorologicall bookes, are full of argumentes, and effectuall demonstrations of the vertue, operation and power of the heavenly bodies, in and upon the fower Elementes and other bodies, of them (either perfectly or unperfectly) composed"(62)) laid it down that "the earth is bound up in some necessary way with the local motions of the heavens so that all power that resides in this world is governed by that above," (63) a statement Aristotle elsewhere clarifies further by declaring the motion of the stars from east to west to represent the principle of permanence and growth, and the motions of the planets from west to east that of change and decay, in earthly things (64). Moreover as there seemed also to be some scriptural justification of astrology — as the stars which fought against Sisera and the one which foretold Christ's birth and the Magi interpreted (65) — too complete a rejection of it might carry with it the suspicion of indicating infidelity, impiety, or a scoffing atheistical attitude. "I refer you," writes Worsop, in the main a particularly hostile critic of this science, "....to the learned Melancthon....who called them Epicureos Theologos who impugn the lawfull science of astrology" (66) and Tycho Brahe declares "Astrorum negare vires et influentiam est apientias et prudentiae divinae detrahere, ac manifestae experientiae contradicere."(67) While Dee scribbles against Pliny's rejection of a Providence at work in the world, through the mechanism of the stars, the comment "Deliriu epicuri."(68) This attitude is very closely connected in turn to an argument which carried great weight when the universe was conceived as governed by purpose, because designed for some end by God, and a purpose which could not be wholly foreign to man's nature and might have considerable reference to it — this argument is one based on what might be called the principle of sufficient reason. Raleigh employs it when he writes "It cannot be doubted but the stars are instruments of far greater use than to give an obscure light, and for men to gaze on after sunset," (69) as does Tycho when he holds the astrological virtues of the

stars follows necessarily from what we know of the whole of the rest of creation, in which "Nulla enim herba tam exigua, nullum minerale et metallum tam abiectum, nullum animalculum ita vile, quin insigni aliqua ac propria et specifica virtute sit praeditum."(70) Thus Dee says in scorn of the Light Despisers "Lo the Sunne, Mone and Sterres (being so many, so pure, so bright, so wonderfull bigge, so farre in distance, so manifold in their motions, so constant in their periodes, &c.) they assigne a sleight, simple office or two and so allow unto the (according to their capacities) as much vertue, and power Influentiall, as to the Signe of the Sunne, Mone and seven Sterres (hanged up for Signes) in London, for distinction of houses, and such grosse helpes, in our worldly affaires."(71)

VII. The distinction in Natural Philosophy, between astrology and astronomy, based on the relative status given to each by its method and subject matter, to which Dee subscribed, is common to a large number of thinkers of the day; it is fundamental in type, arising strictly from considerations of general theory, and indicative of the kind of homogeneity of outlook which could underlie superficially wide divergencies of particular views (resulting from varying evaluation of the practical value, or spiritual meaning of astrology and systems of interpreting its data). Thus Dee notes in the margin of a prefatory treatise in his volume of Ptolemy (72) that method in these two sciences exhibits the difference between "a priori and a posteriori Demonstration." The passage in Salius' text that the note refers to is more ambiguous than distinctions usually made by later writers (the edition appeared 1514), but it is on the same lines. It distinguishes sciences which are in possession of knowledge which allows them to proceed demonstrably, that is by necessary steps, from causes to effects (as the astronomer can demonstrate what the present state of the heavens must be, knowing what has been, or their future state from the present), and those sciences which have, as far as demonstration goes, to work back from effects to causes, which is the procedure on which astrological knowledge is based; for it discovers what are the mundane effects of various conjunctions by observing earthly changes and assuming the state of the heavens then maintaining to produce them. It has no means of determining in advance of such a procedure, by deduction from known first elements or merely from an examination of the stars and planets themselves, the qualitative changes these "naturally" produce, and the variations which result from differing angles and aspects, since the principle of such operations remains largely unknown, and they themselves are only to be gathered by experiment.

Salius confuses the issue by suggesting that in its forecasts, when it has thus been founded, astrology can also claim to be using "a priori demonstration" — a position not usually adopted by others who make a similar analysis, though they might claim some a priori basis for astrological knowledge on other grounds. The term "a priori" — as applied so frequently to astronomical knowledge (as also to mechanical etc.) to contrast it with other known facts and collections of facts in astrology (or medicine) — clearly does not relate to the type of content, empirical or otherwise, or to the part played by observation in suggesting its laws or even providing initial data, but rather is a judgment of the grounds on which a conclusion made within that science is held to be true (73). Astronomy was considered "a priori" not merely because it was largely a mathematical science (so that, granting to the celestial bodies a cyclical uniformity of behaviour and that their motions admit of complete mathematical descriptions, then predictions were uncontrovertible and every step between their various states "intelligible"), but also because most of the primary facts and principles that were known by observation, seemed to be demonstrable by other means, and to be necessary rather than contingent since they could not be otherwise without involving contradiction — which was not the case in astrology. The best examples of such astronomical facts known by reason are the arguments in Aristotle's de Caelo — Recorde is but one of many who, though in other respects critical of Aristotelianism, continue to employ them in the sixteenth century: for instance, the Universe or outer sphere can be demonstrated to be spherical: because there can be nothing beyond it and it revolves, but the sphere is the only body that can do this occupying the same space all the time; because the sphere is the primary solid, for it is bounded by a single line and in nature the simpler is always a priori to the composite; because this sphere's revolution is the standard of measurement for all motion, but the measure of a class is its smallest member, while the circle is considered here as the shortest path in which something can start and return to the same point. Similarly the revolution of the heavens can be shown to be constant since all variations in motion must be stages in a finite motion with beginning, middle and end, but circular motion admits none of these, and is eternal (74). Such conclusions, as also the circular paths (or the circle as the element in the apparent paths) of the planets, which followed from the nature of the circle as compared to other figures and that of the heavenly bodies compared to other parts of creation, were not regarded as inductively determined, but as being themselves self-evident principles, or as derivable from such principles. Such reasoning, in contrast with the former cause for labelling astronomy "a priori" — that it was a science almost wholly controlled by mathematics — became more infrequent, and more restricted, with the spread of Copernicanism as an alternative to the older hypothesis — though supporters of

this system refashioned arguments of a similar type in its favour — and the idea of the possibility of the infinite extent of the universe.

That astrology however was founded on, and could only be developed by, direct observation, that it represented a summary of experience, since the manner of the operations by which particular effects arose from their supposed causes remained here "occult," and inevitably conjectural (as was not the case with effects such as eclipses described and predicted by, astronomy), that it was more an "art" than a "science," was a view which could call a lengthy list of authorities to its support. Manilius could be interpreted as inclining to it, when he wrote with particular reference to astrology

"Per varios usus artem experientia fecit,
Exemplo monstrante viam."(75)

Roger Bacon denies that its conclusions can be called "necessary" in the same way as those of mathematics, its foundation must remain provisional, for, though the heavenly bodies may always act in a certain determinate way, what this is can only be gathered from observation of earthly events to which they are only contributory causes, in so far as they act directly, and our conclusions are therefore very liable to error; a shipwreck, Bacon points out, may be still produced by faulty navigation though the stellar influences at the time were in fact, beneficial (76). The largely qualitative nature of its subject matter, and the way it had to be investigated which pointed to the distance separating it from pure mathematics — the type of apodeictic certainty, determined its position as a subordinate science. In Tartaglia's Italian translation of Euclid a list of authorities are produced for effecting a division of the sciences usually called mathematical, into pure, such as geometry and arithmetic, and mixed, or "mediate," dependent on the former but incorporating matter from natural philosophy; and this class includes most of the others of importance, such as music, perspective and astronomy — "eccetuandola astrologia guidiciaria laqual egli conclude esser pura naturale, in quanto alla sua essentia."(77) Though some such as Dee attempted to give theoretical accounts of its basis, and operations in quantitative terms, the distinction in practise largely remained. Garcaeus in 1576 writes that although long known by one name and frequently confused, astronomy which is sister to mathematics is to be distinguished from astrology which is the child of physics; this latter is a subordinate science — in part a dependent one — "hoc Physicum ex priore Mathematico oritur" — dependent in so far as it can draw from mathematical astronomy some part of its methods and data, but distinct and less certain altogether in that it can be properly established only by traditional experience (78). Tycho Brahe observes the same distinction, summarising "Astrologia igitur a posteriori, hoc estab ipsa experientia sua sortitur principia, et a multis particularibus varius fallentibus observationibus universales constituit conclusiones: non aliter quam in arte medica fieri assolet."(79)

While all astrology was not regarded as experimentally verified and much reliance in the interpretation of horoscopes had to be placed on tradition, enough seemed to be provable to give retrospective support and credit to the practice and general theory of the natures of the planets and zodiacal signs, and of the relation between the heavens and earth, as employed by previous generations of astrologers; and these theories once accepted, an indefinite number of detailed conclusions could be drawn from them by speculative deduction. At the same time what is noteworthy is the attempt of many sixteenth century astrologers to provide an inductive basis as far as was possible for their science. Thus one of Cyprianus Leovitius' works tabulates all the major conjunctions, trigons, etc. throughout history, and along with them the chief mundane events that have occurred at such times, and then on the basis of what may be concluded of planetary effects from these correlated data, adds a provisional forecast for the next twenty years (80). Leovitius had earlier brought out a treatise which appeared in the same volume with complementary works from Wolf and Dee (the Aphorisms of 1558) entitled Brevis et perspicua ratio iudicandi genituras, ex physicis causis et vera experientia extructa, which treated judicial astrology on similar lines; it is a series of comparisons of nativities with the character and fortunes of the person concerned made with considerable minuteness and with regard to a restricted number of special topics. Dee from the Preface, seems to have made a special study of the "Star of Jacob" and its "effects," this and "my constant and invincible zeale to the veritie in observations of Heavenly Influences (to the Minute of time) then [1548-1549], so diligent," (81) led him to write the Aphorisms in which he

attempted to suggest a mechanical basis and a mathematical method for interpreting astrology. The importance of this approach is that such serious and exact treatment of astrology, the insistence on it as observational, open to correction from experience, and something to be only admitted in so far as it could be brought into coherence with general physical theory, meant ultimately the signing of its death warrant; not the denunciations of its opponents, which were in this respect powerless, but the investigations of those who supported it or adopted it as a working hypothesis, were eventually to dispose of its claims to be a genuine part of scientific knowledge.

This habit of mind which Dee largely evidences was however by no means universal even among "serious" astrologers, i.e., those who made a genuine effort to integrate it with their general physical and philosophical theories. It must be sharply distinguished from that tradition for which Plotinus is perhaps the most influential early source. This had its special dangers in that it denied the possibility of any rational explanation in physical terms, such as Dee hoped would someday be discovered, for observed correspondencies between celestial and earthly occurrences, while it received perhaps wider encouragement than such theories as Dee advocated since it was all too frequently an acceptable formulation to the multitude of those otherwise opposed to astrology on religious grounds, whose hostility was aroused far more by the suspicion of materialist determinism which otherwise attached to it than by its social abuses. Philo expounding Genesis 1, 14 (82), had deduced that the stars were created as signs by God to provide certain information to men about coming events, but avoided suggesting in any way that they were themselves causal agents; Plotinus developed this same theory; the stars may signify the future but no direct effects are to be attributed to them; that they can so signify he explains by referring to the relations of harmony which maintain between all things and which are in turn witnessed to by this: "The symphony however, of souls with the order of the universe...is testified by this, that their fortunes, lives and deliberate elections are signified by the stars."(83) He was followed by Macrobius (84) and many others, and the doctrine proved popular since it could be adapted to a form which did not threaten free will, any more than did God's foreknowledge, and celestial phenomena could be taken merely as the signs He employed to express that part of it He wished revealed; nor did it limit God's power, nor, as the other view was, wrongly, thought to do, did it impair the dignity and purity of the stars by implying that they could produce evil. Thus Recorde, though he announces his intention of writing a whole book "on Critical (or Judicial) Days" (85) and says of astrology "without it physicke is to be accompted utterlye imperfect" (86) adopts the Plotinian position, seemingly for religious reasons, and does not attribute any causal efficacy to the stars (87). Another rather different example of the "non-mechanistic" astrologer is Cardan. Since his personal philosophy was dangerously heterodox, and seems to have combined determinism with a universal animism — which makes his view of causality primarily "magical" — it is frequently only obscurely expressed in his writings; thus he resolves the objections to astrology which follow if one denies the direct effect of the stars, or their conscious knowledge of the future (God is not mentioned) by a none too perspicuous explanation relying on animistic relation of sympathy; "Praeterea quamodo astra cum nesciant ipsa, nos quae nesciut docere possunt? Nequi illud significare possunt per causas, cum nondu causae paratae sint, sed ex ordine illoru hoc pendet. Ordo aute ad fatu, non ad astra pertinet. Nam astra ordine tenentur, nec illum ostendere possunt. Itaq; hoc antiquis difficilimum uisum est. Sed intellectus qui in astris est quod potestate est sempiterna, per illa in animam infundit; velut in mortalibus animalia praesentiunt aeris mutationes antequam fiant & antequam causae illarum sint."(88)

Those who held "Plotinian" views are usually found to be such as while having considerable interest in the actual business of casting horoscopes and making predictions, were not concerned to investigate the general theory of astrology or render it coherent with an overall scientific interpretation of the world, and moreover hoped thus to rescue astrology from charges of derogating from providence levelled at it by religion. On the other hand those who did not fall back on this Plotinian evasion, had to meet such accusations in a different way, and while the mechanics by which the heavens were supposed by thinkers such as Dee, to produce their effects can be left until the discussion of Dee's own writings on the subject, it must here be pointed out how this class of astrologers held both that the operations of astrology were wholly natural and that they nevertheless did not threaten the freedom of the will. Astrology, writes Wolf in his apology

for it prefixed to Dee's Aphorisms, "est doctrina de effectu syderum in elementis, et iis rebus quae ex elementis constant"; the predictions it permits do not trespass on God's prescience, since they provide only another example of the way in which (as contrasted with God's immediate nondiscuisive knowledge of past, present and future) "Homo ad futuroru cognitione fambages pervenire conatur," which is a wholly legitimate attempt, apparent in all sciences whatsoever, which interpret some feature of a present state of affairs which can be considered either as itself causal or as the invariable accompaniment of some more "occult" cause whose presence it therefore indicates, in order to predict a future happening. "Nemo impietatis damnat agricolas si ex ratione tempestatum, de proventu frugum; nemo item medicos, si ex habitu corporis, ex tactu pulsus, & inspectione vrinae, de valetudine et vita hominis: nemo eruditos & prudentes viros si e statu praesentium rerum conijciant & divinent quid paulo post in Republica futurum sit. Quae igitur inuidia est, solis Astrologis impietatis crimen impingere?"(89) But though predictions might be absolute as regards happenings in the elemental world, in the field of meteorology for instance, in respect of all events in which man was concerned the judgments of astrology, said Dee were to be held as holding a mediate position between the necessary and possible (90). This was a position which followed from the acceptance of the dual nature of man. Thus Tycho Brahe after explaining the influence of the stars on the physical world, continues "Cum enim homo ex elementis constet, et a terra plasmatus sit necesse est, ut easdem conditiones subeat, quad obtinent res, e quibusconstat."(91) The difficulty then arose that in Raleigh's words it would be impious "to ascribe to them (the stars) the same dominion over our immortal souls which they have over all bodily substances and perishable matter."(92) The difficulty was the same as medicine had to face, and astrology gave the same answer. The stars, said Roger Bacon, work upon men through their bodies, and therefore affect their wills and characters to the same degress as the humours may be allowed to do so (that they do so act upon men he holds as proved by the difference in "temperament" which may be observed to maintain according to both country and latitude — he does not regard this phase as a pleonasm, the "countries" are almost natural units to him) (93). The solution which became classic, and involved an important distinction between judicial and general astrology, lies in Ptolemy's dictum that the stars incline but do not compel. It was clearly compatible with orthodox theology and Aquinas develops it in the Summa (94): the stars control the bodies of men, and hence act upon the intellect which is affected by the state of the body, but the will is not so governed though it is inclined by the passions, which have a physical origin: but this statement carries the rider that most men are slaves to the passions, and perhaps the major part of the actions of all men are prompted by them. Hence while predictions relating solely to the future of the individual (judicial) are purely contingent, those relating to major historical events, and social changes can be taken as having a high degree of, or even absolute, certainty__an interesting early example of a science defending its conclusions by theoretical considerations of probability, and proclaiming a determinism in large-scale happenings and at the same time the indeterminateness of the actions of the individual elements which compose these. Similarly an anonymous English writer (late 15th century) tells us that the planets form the temperaments of men, giving a certain tendency to the development of their character and average behaviour by "whiche moste generally and Naturally men so frameth and fashyoneth himselfe as in a curse a Bias is to the Bowle, so on lesse God his Grace dothe contrepaies, being thereto excited, dothe refrayne suche affeccions, but Tholomeus sayth the wyse may governe and have lordship over the sterres and withstand that they dyspose. Ut dicitur sapiens dominabitur astris."(95) That Dee subscribed to this account of judicial astrology, and that he was prepared to make use of its conclusions along with any other source of information available bearing upon any question, appears from a letter he wrote much later to his friend Camden, on his son Arthur whom he had put to school at Westminster, where Camden was then (1592) a master. "He is of an exceding great and hauty mynd naturally, ready to revenge rashly. The naturall inclination is to me evydent: as who hath in horoscopo and in corde Leonis. Dictum sapienti sat esto: for vera curatura you may alter this naturall courage to true fortitude and not to frail rash fancy as Socrates did overcome by grace Divine and his industrie, his untowardness, signified by the Art physiognomical — you know the historie."(96)

The attitude of Dee and other "serious" astrologers towards their science is far more

frequently characterised by moderation and balance than is the case with the opponents of astrology. They interpreted with caution, regarded its indications as provisional, and especially so the more particular these were; they employed it for its great utility in life, but looked on it as a field for investigation rather than dogmatising upon; this became a fairly fixed view of the generally cultured person for a long time. Thus Herbert of Cherbury could write in the mid_seventeenth century "When it (Astrology) is rightly understood and applied it be not only a lawful but a most necessary art for a wise man; as long as he takes only general predictions from thence without presuming to foretell particular and single events, otherwise than as they depend upon general causes, since they who descend too far into particulars either err or speak truth by chance."(97) The science — or rather "art" — which astrology is most frequently said to resemble is medicine, where the methods of diagnosis — an argument from effects to cause__and prognostication of the course of a disease were taken as comparable with the procedure of astrology; the two were alike in their utility, and empirical foundations, in the large amount of conjecture they contained, and in the very fallible nature of their forecasts, to both of which last their practitioners themselves freely admitted. The attacks on astrology in the sixteenth century usually proceed along standard lines of argument drawn from Pico, and usually betray ignorance of the technical issues involved and misunderstanding of the nature of the claims made for it by contemporary scientists as against the abounding charlatans (98). The character of these criticisms may be briefly noted however as they serve indirectly to define the position of astrology in Dee's age. They can be distinguished into those prompted merely by the social abuses which accompanied it — a feature which none censured more thoroughly than the defenders of astrology themselves (thus Dee denounces the "Light Practisers "severely in the Preface but he notes approvingly a passage in Milichius' "On the Dignity of astrology," referring to Pliny's rejection of it, on account of the abuses and imperfections he exposes — "Non solum stulticia sed perversitas est aucipari ingenii laudem ex infectatione bonarum artium" (99)) and those which ventured more fundamental criticisms. The first were much the more numerous; it is Reginald Scott's excuse for his hostile passages that "though there be many of them (astrologers) learned and godly yet lurke there in corners of the same profession great numbers of counterfets and coseners."(100) Even vicious satires such as Tomkin Albumazar (1615) will frequently go out of their way at some point to declare that they are only aimed against knavery, and not against the true practice of "that sacred skill, That in the Starres reades all our actions."(101) Since he was the most renowned of their opponents, efforts were made by astrologers to interpret even Pico's criticisms in this way, though he had explicitly declared that the effects of light and heat (or motion) were the only influences to be attributed to the heavens. Thus Tycho Brahe argues that Pico's extreme disgust with the frauds and cheats masking as astrologers is the real motive for his attack and accounts for the over vehemency of his book; "in quo tamoo, non tam artem ipsam, et huius solidiora molimina quatit, quam Astrologorum imperitorum supervacaneas Naenias prodit quas nemo secretiori et veriori Astrologia addictus unquam probarit."(103) This view gained colour from the apparently astrological nature of some of the Theses, and from the way in which his doctrines of natural magic, which Pico never renounced, seemed bound up with it (104). Thus Bodin denounces the Florentine Academy for cultivating the astrological_magical arts of Pico, who taught how to effect a linking of the powers of the heavens and the earth for the practise of magical operations (105).

VIII. The motives for a total rejection of astrology can nearly all be identified as religious or purely philosophical in origin, and those who advocated this seldom show any concern for scientific practice, or interest in standards of truth possibly attainable apart from these. Pico's work — which so impressed Savanarola that he directed an abridged vernacular edition to be prepared — wears amore rationalistic air than Calvin's (106), but they are nevertheless closely similar, both in the negative feature just noted, and in finding the same dangers in astrology__that its practitioners are likely to make the will of mann, and his life, only one link in a sequence ruled by purely natural causation. Thus Pico's chief target (as it is still John Chamber's in 1601) is Guido Bonatti, a rigidly deterministic Aristotelian astrologer of the thirteenth century, whose works, which Pico seems to take as representative, were rejected with equal vehemence by the majority of Renaissance astrologers themselves — Lucius Bellantius stigmatises him as being both thoroughly impious and ignorant (107). However there is no doubt that such views as Bonatti's might be sometimes held by astrologers. Thus by imitating the heavens Al Jabir had claimed man might attain powers which religion usually allowed to be the sole prerogative of the Creator, and even produce life — he gave a receipt for the making of an homunculus, the chief piece of apparatus for which was a model to reproduce the motions of the stars and planets, in the centre of which the "egg" was to be placed and where it would, under the influence of the artificial universe whose power resided like the real one, in its figures and patternings, germinate and grow (108). Again, one of the thirteen errors condemned at Paris at the end of the thirteenth century, said to be drawn from Averroist doctrines, had been "Quo domnia, que hic inferius aguntur, subsunt necessitati corporum celestium."(109) A suspicion of similar over naturalistic doctrines attached to Pomponazzi who, in addition to the generally sceptical tenour of his works on the soul, in de Incantationibus, rejecting all demoniac or angelic activity, attempted to supply natural explanations for all marvels, miracles, and "supernatural" occurrences, a problem he thought to have solved by postulating astral influences at work in all events (110). Cardan's astrological teaching was similarly suspect; the attitude implied by his drawing up the nativity of Christ seemed impious and objectionable, its defence sophistical. Yet even Roger Bacon had placed the religions of the world under the several planets, and allotted to each a period of growth and decay according to the celestial revolutions, and many as genuinely religious as he, or believing themselves as equally orthodox in their profession, adopted in some measure similar views, Dee himself does not seem to have been wholly free of them (111).

The astrologer's defence against charges of irreligion we have already noted. Nor in their criticisms of the methods of his science were his opponents on any firmer ground. Pico's denunciation is again the storehouse of almost all that were employed, but they were already ancient when Pico undertook to refurbish them; most do not represent any advance on the objections of Carneades which Ptolemy had already answered thoroughly in the Tetrabiblos (112), and they were easily rebutted by a host of scholars for the most part better informed than he (113). Objections were based on the complexity of the data and difficulty of accurate observations, but none were better aware of these than the astrologers. That it was irrational to take the conformation of the stars at moment of birth as conditioning character and fortunes, since there was no better reason for taking this point rather than any other, e.g., the moment of conception, of the infusion of the soul (Chamber (114) lists seven occasions he thinks should have as good or better claim to be considered the crucial astrological one than time of birth) was answered as soon as the inductive foundation of astrology was insisted on — that the qualities ascribed to planets and constellations were mere descriptive summaries of effects obtained by the correlation of earthly and celestial occurrences; hence, since one of the sequences involved, the motions of the heaven, was uniform and regular, and each state necessarily linked to preceding and following ones, so that knowing the position of the heavens at one moment their past and future could also be known, since this was so, it was of no importance which point as long as it was some one crucial, common and determinable occurrence in a man's life, was taken as the time for examining the state of the heavens which controlled his destiny, providing that the same occurrence in every individual's life was always taken. Astrological knowledge had been built up, it was claimed, by comparing men's lives with the conformation of the heavens at their birth, it could therefore be used for trustworthy predictions as long as this same occasion were taken, without necessarily ascribing full causal

determination of the future to the particular conformations of the stars at that moment and without producing any deeper medical or metaphysical justification of the moment of birth as the only correct occasion for erecting the horoscope. But the critics, here and elsewhere, showed a blind hostility, or ignorance, as regards the most usual, or accepted positions of contemporary natural philosophy. Thus the argument from the case of twins loses its air of good sense in the form it is more than once urged by English opponents of astrology who hoped naively in this way to improve its cogency; is it possible that the future was the same, though the figures of their nativities must have been identical it is asked, for all the children of the Countess of Holland, who had 365 "al hatched at once" — in John Chambers' phrase (115) (supposedly on Good Friday 1276, as the result of a beggar's curse). A typical attack, exhibiting the most usual temper and line of argument is that of Stubbes. Astronomers and Astrologers he confounds together as "a certaine kinde of curious people and vainglorious," employed upon "searching the secrets of God rashlie, which he would have kept close from us, and onely knowne to himself"; "I wonder" he says, lumping together the teachings of each science, "what spirits tolde them which planets were higher than other and which lower than other, which be good and which be evill, which be moist and which be drie....with infinite like fooleries which I overpasse....but certaine I am that out of the booke of God they never fetched them." Their science "standent upon nothing else but mere coniectures, supposals, likelihoods, ghesses, probabilities, observations of times and seasons, coniunctions of signes, starres and planets...."; yet on these uncertain grounds they overturn the order of Genesis in which God gave man power over the creatures and not vice versa. "Will they have the dumbe and unreasonable creatures to rule the reasonable?" he demands and develops this to a point where he seems only to admit causal efficacy as possible when accompanied with conscious intentions, declaring it to be obvious that since the stars are insensible and lifeless they cannot affect living beings or cause their deaths. To grant stars power is to take power from God, hence "It is time these phantasticall felowes were looked to in time, that wil go about to disthronize the mightie God Jehova of his regall throne of maiestie and Glorie making an Officiperda of him, a iacke out of office, and to pull him (as it were) E coelis, out of the heavens, downe to the earth, giving him no power nor authoritie at all." Stubbes then suddenly admits that signs and planets produce effects on the world whenever God chooses to operate with them, but do not "worke these effects of their own proper force and strength," and finally allows that astronomy is lawful insofar as it produces almanacs, calendars and other practical benefits__he significantly has nothing to say of it as a speculative science, as an aid to the construction of a general cosmology (116). Indeed it is insofar as astrology seemed to suggest the possibilities of conceiving a mechanical automatic universe, not requiring the continuous supervision and direct miraculous intervention by God, that its critics frequently show themselves as chiefly suspicious of it. "For if all our actions depend of the sterres" declares Chamber, "then may God have an everlasting playing day and let the world wag" (117); and indeed those who saw no difficulty in reconciling astrology with Christianity, frequently picture the world, and God's relation to it, much after the fashion of Boyle or Huygens. Thus Hakewill writes "Neither were it hard to adde much more to that which hath been said, to shew the dependence of these Elementary bodies upon the heavenly specially out of Cornelius Gemma....and Mizaldus....Almighty God having so ordained that the highest should serve as intermediate agents or secondary Causes betweene himself and the lower: And as they are linked together in a chaine of order, so are they likewise chained together in the order of causes, but so as in the wheeles of a clocke though the failing in the superior, cannot but cause a failing in the inferior; yet the failing of the inferior, may well argue though it cannot cause a failure in the superior."(118)

IX. Before the introduction of the telescope — which gave a stimulation in a radically novel form to astronomical studies, opening up new vistas and wide fields for direct discovery, astrology with its insistence on the need for ever more accurate observation and calculation, a demand gaining force from the great benefits it promised, did good service in maintaining interest and promoting improvement in astronomy. But the utility of their science, either in this respect, or in the assistance it lent to navigation and calendar making is inadequate to explain the almost religious fervour with which Dee and others speak of astronomy. Tycho Brahe records how on first witnessing an eclipse of the sun (1560, 21 Aug.) it struck him "as something divine that men could know the motions of the stars so accurately that they could long before foretell their places and relative positions," (119) and a mingled wonder and reverence pervades all his general discussions of the subject. But a consequence of the astronomers' excessive lauding of their science was that it aroused the same type of philosophical and religious opposition as astrology. Alexander Ross, chaplain to Charles I is a good representative of this kind of opposition — although writing in the seventeenth century he seems to belong to an earlier age; at least he would not have appeared in the previous century so scientifically negligible a figure. He extends his dislike of Copernicus to a general denunciation of the pretensions of astronomers; with Lactantius he calls them "furious and mad men," takes the falling of Anaximenes into a ditch while gazing at the stars as a symbol of the destiny of the whole profession, rebuts any claims for astronomy's special nobility or universality, and, although allowing it utility in a very limited practical sphere, proceeds "But that which I reprove is the vain curiosity of men, who cannot be content to know with sobriety things revealed, must needs with Phaeton and Icarus meddle with these heavenly bodies in vain and curious speculations — the knowledge whereof in this life is denied us as being a part of Adam's punishment for his affected knowledge, and being a means for us to have recourse to Christ....As it was God's proper work to make the earth, so it is proper to him alone to know the measure of it."(120) Dee was certainly one such as Ross "reproves," he is never weary of discoursing on the sublimities and beauty of astronomy, regards it as the highest of all the sciences which deal with things, as concealing in itself all the divine mysteries. It is an attitude which was possible either from Aristotelian or Platonic principles. Some Averroists maintained that the universe would have to come to an end — become chaos — if so much as a single star were to disappear. Cicero's contrast between the celestial and sublunar worlds might be regarded as the text for innumerable Renaissance discourses on the perfection of the heavens, e.g., one of Recorde's title pages, that of the Castle of Knowledge, which illustrates the book's theme, showing Urania and Fortune, has verses explaining their various spheres of influence, which are almost a direct translation). "Nulla igitur in caelo nec fortuna nec temeritas nec erratio nec vanitas inest contraque omnis ordo veritas ratio constantia; quaeque his vacant ementita et flasa plenaque erroris, ea circum terras, infra lunam (quae omnium ultima est), in terrisque versantur."(121) But Dee seems by his attitude towards disputed questions, consciously to follow a Platonic account. He rejects or at least completely disregards the Aristotelian quintessence, seeming to consider the stars as of material substance not unrelated to matter encountered on the earth, if of a refined form (in the Timaeus, although the fifth regular body is used in the construction of the stars, it is capable of transmutation — by rearrangement of its "atomic" triangles — into three of the other "elements"). The Epinomis which almost inculcates a cult of star worship, Dee refers to several times with the utmost respect ("which boke" he says, "is the Threasury of all his (Plato's) doctrine"(122)) and although material, he describes the stars as "these most pure, beautifull, and Mighty Corporall Creatures," (123) Dee similarly does not regard the stars as unconnected with "intelligences," or necessarily inanimate, and from his prayers and incantations, employed with Kelly in scrying would seem to involve the belief that various angels govern, or represent "Principles" which govern the individual planets (as in Trithemius' de septem secundeis) and he appears to hold in the Monas and elsewhere that celestial motions are expressions of divine truths which can be rationally comprehended through them, and are themselves akin to the soul ("evil," , the Cratylus had etymologised as "that which moves badly" and , virtue, as meaning the ease of motion, constant and unimpeded, fitted to the good soul (124)).

The heavens Plato had declared partake of a "bodily nature and are therefore not immutable, but they try to maintain a uniform motion," (125) and in doing this they become for him of the

highest importance, since in Solmsen's words: "In regular and eternal movement Change coincides with Sameness, and alteration loses its arbitrary character and attains a quality of perfection."(126) They were an example of a resolution of the dilemma posed in the Theaetetus and elsewhere: if Reality were unchangeable no intelligence could exist, if it were all flux no knowledge could exist; intelligence had to be in motion, its objects constant; the combination was apparent in the heavenly bodies which moved (and were hence rational), but whose paths were regular and constant (representing the object of their intelligence). The heavens Plato asserts more than once are "a living creature and endowed with intelligence by him who fashioned it in the beginning."(127) (For the "law" which we recognise in the regularity of the celestial motions is for Plato a proof of their rationality, and being akin."(128) The stars are visible gods in the contemplation of which, according to the Epinomis, man is assured of wisdom and happiness: it is not wholly a novel doctrine — "Do I not even believe that the sun or yet the moon are gods as the rest of mankind do?", Socrates is represented as demanding rhetorically in the Apology (26D) — except that the proper worship of these "Gods" for Plato, is the thorough and exact scientific study of them, and philosophical speculation about them — courses which popularly might carry with them a suspicion of "atheism." Despite his emphasis on the scientific study of the stars, des Places suggests that the astronomy which Plato praises would be better termed "astrolatrie," "et c'est bien une religion astrale que l'Epinomis propose aux Hellenes a cote de la religion delphique," and this is "une consequence naturelle....de la croyance de Platon que seule une ame peut causer un mouvement.(129) The moral and religious benefits of astronomy are a frequent theme with Plato. Discussing the etymologies of the names of the Gods he derives "Uranus" from the phrase "gazing on things above" and asserts that it is this looking which makes men of pure mind (130). In the Laws he writes of the heavens, "no man that views these objects in no careless or amateurish way has ever proved so godless as not to be affected by hem in a way just the opposite of that which most people expect," since the populace imagine that such men "become atheists through observing, as they suppose, that all things come into being by necessary forces and not by the mental energy of the will aiming at the fulfilment of good." On the contrary, Plato argues, astronomers know best that even the stars themselves must have "souls" (in the sense perhaps they are able to respond to the guidance of reason as their regular motions declare) since otherwise they "could never have employed with such precision, calculations so marvellous" as their courses have evidently required; and indeed "it is impossible for any mortal man to become permanently godfearing, if he does not grasp the two truths," the first concerning the soul's immortality, the second, "that reason, which, as we have often affirmed, controls what exists among the stars together with the necessary preliminary sciences."(131)

The religious import of astronomy, that it is not only to be studied for itself but for the sake of these metaphysical truths for the understanding of which it is necessary, is likewise the burden of many Renaissance astronomers, frequently accompanied by explicit reference to Plato's authority, his description at the end of Timaeus of birds as reincarnations of "harmless but light witted men who studied the heavens but imagined that the surest evidence in these matters comes from the eye," was accepted as at least a just allegory (132). Another recurrent subject of speculation, in its general statement accepted axiomatically by most Renaissance thinkers, is the relation between the individual soul and the celestial movements. It has a long history (being bound up with the microcosm-macrocosm analogy) after its expression by Plato (Aristotle summarising the cosmology of the Timaeus says "The revolutions of the Heavens are regarded as the motions of the soul" (133)). What or such a view is to be found in the stars is an ideal to be imitated in the individual life. Thus when Philosophy appears to Boethius in his dungeon, he addresses her "Talis habitus talisque uultus erat, cum tecum naturae secreta mirarer, cum mihi siderum uias radio describeres, cum mores nostras totiusque vitae rationem ad caelestis ordinis exempla formares."(134) A phrase which Dante echoes "wherefore the human race is best disposed when it follows the track of heaven insofar as its proper nature allows."(135) It proved a dogma that gave wide licence to much mystical or magical speculation in the Renaissance, and drew support from Plotinus' considerations of the "figures of the heavenly bodies" and their significance in connection with his teachings of the "universal sympathy."

The temper and arguments of Plotinus' Against the Gnostics in which the chief grounds of

his attack were that these men do not sufficiently recognise or honour the beauty of the heavens, which deficiency must stultify the good in any creed they hold (136) — are very similar to declarations of Renaissance astronomers when praising their science or replying to real or possible objections from a theological standpoint to their supposedly excessive concentration on it. Such writings are almost always characterised by a close interweaving of aesthetic and religious enthusiasm combined with the assertion that here at least is an object of study worth of the greatness of man's mind. "Quid quaeso" writes Tycho Brahe "pulchrius et homine dignius esse potest, quam immensam illam caeli machinam, luminarium stellar unque omnium exquisitas et admirandas vicissitudines motuumque jucundissimas harmonias suo submittere ingenio."(137) Thomas Hood, in his inaugural address as mathematical lecturer in the city of London 1588, makes the understanding of astronomy a moral duty for man: "For Right Worshipfull: there is more required of us men concerning Heaven than the only view of the outward frame; the beastes themselves can view the thing, they can behold it as weld as we, but wee must treade the footsteppes of Adam and Seth his Sonne, whose study was continuall in these thinges."(138) Dee's pupil Digges writes in a work, published in the same year as one upon the same subject, as one by Dee and perhaps designed to be bound into a single volume with it "Cum igitur exquisita assiduaq; Machine Coelestis contemplatio vehementissime aut excitat confirmet in hominum animis de Deo opinionem, non sapienter solummodo sed religiose etiam Platonem dixisse iure confiteri debemur Astronomiae causa oculos hominibus esse datos: sunt enim praecipue ob hac causam hominibus dati, ut a querendam aliquam de Deo noticiam (Infidis etiam et Ethnicis) duces essent, eclectis aute, ut admirabilis quasi Harmonie dulcissima titillatione excitati, alacriores ad (Dei optimi maximi) laudes ex intimis anime penetralibus ebuccinandos sint" (139); and proceeds to correlate atheism among ancient philosophers with the neglect of its study, and to declare a belief in providence, and immortality dependent functions of a knowledge of it. Dee's own views will be treated in detail later, but they could be no more faithful summary of them than the remarks of Synesius (a philosopher much read by Renaissance Platonists) on this subject — "l'astronomie est deja par elle-meme une noble science, et elle mene a une science plus divine encore. Je la considere comme la preparation aux mysteres de la theologie: elle a pour objet le ciel dont les revolutions semblent a d'illustres philosophes une imitation des mouvements de l'ame; elle procede par demonstrations, et elle s'appuie sur la geometrie et l'arithmetique que l'on peut regarder comme la regle infaillible de laverite."(140)

Dee even at the early stage of his career covered at the beginning of this chapter may already have had his interests in alchemy aroused, but as it did not become for him a major preoccupation until later in his life an account of his theories on the subject can be postponed (141). It may not be irrelevant to note in passing, however, the special correspondence this science had with astrology. (Reyher writes "qui cupit aliquid ex profundissima Chymiae Scientia ad finem perducere, opus est, ut corpora coelestia bene consideret, earumque qualitates & natures & positiones diligenter agnoscat."(142)) Celestial influences promoted the growth, and natural, evolutionary, transmutation of metals within the earth. Particular metals bore the same names, and signs, and characters as the planets; that they could be referred to by the same designations was to Dee far more than a casual fact, nor did he look on the coincidence as the result of an arbitrary human imposition, or a mere convenience of terminology, since for "cabalistic" reasons he held that these names and signs themselves were possessed of proper and peculiar powers, and were greater "realities" than the material objects and processes they were employed to represent. A formulation which was valid in astrology maintained also in alchemy, for owing to this ambivalence of terms it was difficult to speak of the one without making reference at the same time to the other as is the case with Dee's Monas Hieroglyphica. The physical phenomena of astrology and alchemy could be regarded as particular realisations of a single universal law to be seen more clearly in their signs and descriptions than in themselves. The reciprocity and correspondence supposed to maintain between the subject matter of these two sciences, is an excellent example of what has been called "L'analogie formelle" and described as "le plus grand ressort de la science de la Renaissance" apparent in the Macro/Microcosm doctrines, the foundations of Paracelsian medical theory, and especially "dans la philosophie chimique des neo-Platoniciens." (143) It was in such theoretical aspects of alchemy that Dee's interest chiefly lay — though he engaged at times

in much arduous experimentation — and his was perhaps the usual attitude of scholars to it. The pursuit of wealth was not the genuine end of the study of alchemy — "covetousness" indeed was an attitude of the spirit, which, it was held, would sabotage even correctly performed physical experimentation, and effectively preclude the practitioner from any success whatsoever, and even after the Philosopher's Stone had been attained, the manufacture of gold it was held was only "the lowest use the adepti made of this Materia."(144)

X. The cabalistic teachings which at an early stage of his life engaged Dee's enthusiastic attentions (145), demand fuller notice, as they are an omnipresent feature of his "philosophical" thought, and figure largely in many of his later writings. Their popularity at the time is connected with the spread of the study of Hebrew, a language that had already been introduced into the Cambridge curriculum in Dee's time. Dee confesses in the "Spiritual Diary" that he never attained much skill in that tongue (146) but the general doctrines of cabalah were fairly easily accessible in Latin sources; Postel's translation of the Sefer Yetzirah appeared in Paris in 1552, and Dee was also familiar with the writings of Reuchlin, Agrippa and Pico, who had claimed the honour of being the first to introduce the true cabalah into Europe; while apart from technicalities of procedure much of the fundamental doctrine of the Latin cabalistic writers had far older roots, if only insofar as what might be derived afresh from cabalistic texts coincided and was taken as originally identical with much that was familiar from other sources — the emanation theories of creation linked up with early neo-Platonist cosmogonies, the part played by light in these and its relation to the word was reflected in Hermetic writings (147), while its view of the word only rendered more explicit what had always underlain magical practises, or fused on a higher level with speculations on the Logos teaching of St. John. The cabalah also was regarded in the Renaissance as being an intrinsic part of the thoughts of Raymond Lull, of whose works genuine and spurious Dee formed a large collection (148). Dee's Monad as point, is in many respects identical with the Cabalistic interpretation of the letter "yod" — from which all the letters of the Hebrew alphabet were generated, and hence all words and phrases, and which was the principle of the unity of all things, embodying the law according to which creation proceeded. Dee also employed the methods used by cabalists in their textual interpretations such as Gematria (the substitution of a word for a numerically equivalent one), Notarikon (the expansion of a word into a phrase, by taking each letter of the word as the guide in selecting a further word of which it is the initial) and Themuria (changing one phrase into another by permuting the letters of each word until an order of all the letters is discovered which can be divided into words forming a new phrase). Many of Dee's later occult excesses involved many barren exercises in these and similar manipulations; they were of course recognised already to some extent as being "la partie la plus grossiere, la plus exoterique de la kabbale practique."(149) At the same time, however, no single coherent body of philosophy was to be found simply in the Cabalistic texts themselves. In Lenoble's phrase "Une metophysique se degage en effet bon gre mal gre de la Cabale." This was largely "la vieille doctrine de la hierarchie des formes et de la creation en cascade,"(150) for which the ten emanations, arranged on four levels — of three according to a usual Christian variant which Dee seems to have inclined to (151), were taken as providing a pattern. The formalisation of cabalistic teachings, the extraction of a philosophical system from them, seems mainly to have been the work of the Latin cabalists of the Renaissance, who attempted to integrate it with their general cosmological views. Thus Cheradamus in his Alphabetum linguae sanctae, mystico intellecta refertum — a work that Dee seems to have studied with some care — opens the work, before proceeding to discuss cabalistic methods of "textual criticism," with a general discussion of the Three Worlds — Angelic, Celestial, and Elemental — and of the micro-macrocosm doctrine, and the reflection of the three worlds in various tripartite divisions of man, and also their parallels in the three parts of Hebrew speech, and the twenty-two letters of the Hebrew alphabet, that are divided into two groups of nine letters and one of four, corresponding to the nine orders of angels, nine spheres and four elements (152). The Three Worlds, it may be noted here, were to form perhaps the fundamental theme of Dee's Preface where the doctrine is given an epistemological interpretation — the lower world being that known qualitatively through the senses, and the aspects of the material thus perceived, a mediate realm is considered as that in which the mind reasons upon the objects of mathematics which are native to itself, and in which its activity allows it to attain true knowledge of the other two, since this realm though self sufficient in content, is connected with the others by offering in different ways, a pattern of each, while above this is a spiritual world, where truth, presumably becomes a matter of direct experience, and knowledge is granted without discursus.

A hundred years later Butler mocked at the degenerate cabalists of the day for "hiring old Mongrel Rabines that are three quarter Jews to make their art (i.e., necromancy) as lawful as they can with mighty arguments drawn from etymologies and anagrams."(153). But in Dee's time it

was a legitimate and reputable study; its very recent discovery and availability (in its rabbinical form) was an added incitement, since the rich promise of its mysteries was still largely unexplored. Pico's Oratio de Hominis Dignitate, intended to preface the disputations on the Theses proclaimed the possibility of a semi-cabbalistic key to the Universe as a whole (154) (the long lists of correspondences between letters, and the parts of the universe, of the year, of man, of the moral and intellectual worlds given in the Sephir Jetzirah, and elsewhere were certainly in accord with Renaissance speculative taste, Dee, Cornelius Gemma, and others noteworthy for their scientific activities at ties indulged in the construction of similar analogical schemes). Of these nine hundred theses which Dee in the Preface praised so highly, 47 were cabbalistic, and 72 deduced from Cabbalistic doctrines. Moreover this study was widely though far from universally accepted as in the main theologically orthodox or at least unreprehensible (155). Beroaldus wrote to Reuchlin that the Pope had read his works with pleasure and had caused even statesmen and warriors to take up the study of the Cabalah (156). It was claimed that the cabalistic writings directly affirmed — or the applications of their exegetical methods to Talmudic writings showed these to affirm the Trinity, the divinity of Christ and other Christian dogmas (157); many Jewish scholars it was reported had been converted by their study of it, and it was possible to prevent the destruction of Hebrew manuscripts on occasion by ecclesiastical authority, if they could be claimed as being "Cabbalistic." The influence of Cabbalistic doctrines on the English Humanists of the early sixteenth century has been pointed out by Blau (158), who further observes that "however spread the ideas were widely synthesized with and often indistinguishably introduced into various Platonic systems of thought."(159) This of course was very largely a result of its supposed concordance with Pythagoreanism. Franciscus Georgius (in de Harmonia Mundi totius 1525) declares the Cabalah and Pythagoreanism to be exactly parallel systems; similarly Petrus Bongus (in Mysticae Numerorum, 1585) — who incidentally cites Dee among the list of authorities from whom he has compiled this book, asserts that almost all the philosophy of Pythagoras was derived from the Cabbalists.

Apart from the numerological aspects of the Cabalah of which the similarity to "Platonic" doctrines, and their identical origin was conventionally recognised (160) (Pico distinguishes these, or Sephiroth, from the study of divine names, Schenroth, which he says are the two branches of the Science (161)), the most important Platonic dialogue in connection with the Cabalah is the Cratylus. To say that Plato believed in the intimate relationship of the thing and the word had always been a commonplace. "Thou hast learned in Plato's school," Philosophy says to Boethius "that our speeche must be like and as it were akin to the things we speak of."(162) Chaucer defends a use of coarse expressions to describe vulgar actions — perhaps with Philosophy's speech in mind — on the grounds that

> Eke Plato saith, whoso can him rede
> The wordes moste ben cousin to the dede (163).

Quotations such as these might indicate that no more was supposed to be involved in Plato's doctrine on this point than that there should be a general propriety of expression. But frequently something much more fundamental was intended. The Cabbalists certainly so applied it. Reuchlin says the true knowledge of a thing is hidden in the letters and syllables of the word expressing it, "Quoniam vero nomen, ut in Cratylo, ait Plato, essentiae ipsius est imitatio...."(164), and Agrippa echoes him: the Platonists hold, he says, that the proper force and virtue of an object lie in its true name (165). In Plato's dialogue Socrates holds a balance between Cratylus who believes "there is a kind of inherent correctness in the names which is the same for all men both Greeks and Barbarians" (383A) and Hermogenes, who argues that they are of merely conventional imposition. The conclusion is not definite, and expresses grave doubts as to the possibility of proving the truth and even as to the utility, if this could be done, of Cratylus' doctrine. But to these objections the Cabbalists now felt themselves to be in possession of a complete answer, and accepted without misgivings not merely the concessions Socrates makes to Cratylus in the course of the argument, but the entire position of the latter. In the dialogue, by making the truth of a statement not of a propositional kind, but as something extending down to the smallest parts of the speech, Hermogenes is forced to admit that names themselves may be true or false. "It will I imagine seem ridiculous" says Socrates "that things are made manifest through

imitation in letters and syllables, nevertheless it cannot be otherwise."(425D) An analysis even of personal names is made to show that their meanings are in accordance with the nature of their bearer. Cratylus is admitted to be right in saying that "names belong to things by nature, and that not everyone is an artisan of names, but only he who keeps in view the name that belongs by nature to each particular thing and is able to embody its form in the letters and syllables."(390E) If this could be done words would be a source of genuine knowledge since their structure would show what each thing really is (423E). The ability to do this then becomes an essential part of the lawgiver's function, his work "is to make a name with the dialectician as his supervisor, if names are to be well given" (390D); he must "give all his names with his eye fixed upon the absolute or ideal name."(389D) Some names however, it is even suggested may have been invented "by a power more divine than is that of man."(397C) The pursuit of the principles of correct name-giving and interpretation is carried down through word roots, to the syllables and individual letters; for "if the name is like the thing the letters of which the primary names are to be formed must be by their very nature like the things," (434A) and so an examination is made of the properties of separate letters of the alphabet since "we must know how to apply each letter with reference to its fitness."(424D)

All this, as well as passages from other dialogues — the Phaedrus (244B) says for instance, that the men of old who invented names, thought so highly of the art that they connected it with "the noblest of arts, that which foretells the future, by calling it the manic art" — could be taken to show that Plato subscribed to a similar teaching to that of the Cabalah, and might perhaps have been directly acquainted with it. But the Cratylus ends with the reflection that no man of sense would put himself under the dominion of names or seek certain knowledge merely by investigating these (440C), since as there are clearly both true and false names, even though the true may have been given by a god, we have no means of ascertaining from words alone which belong to each class, and hence are liable to be badly deceived by them; so "it is plain that we must look for something else, not names, which shall show us which of these two kinds are the true names, which of them that is to say show the truth of things."(438A) To these strictures the Cabalists claimed to have a full reply; the solution it was pointed out was already hinted at by Plato, in his admission that the earliest names were of divine origin but were not Greek, for "we got the earliest names from some foreign folk, and the foreigners are more ancient than we are."(425D) The Hebrew characters and language, could be shown, it was believed, to be such an original mirror of creation, and what the Cabalah supplied was the methods for a correct and scientific interpretation of their mysteries. Thus Dee (?) inserts the marginal headings against a section of Cheradamus' exposition of the Cabalah "Platonis sententia de Alphabeto Graeco-Hebraeae linguae laus a comparatione."(166)

The first naming of things by Adam, when he lived in close communion with the divine before the fall, was regarded as being impossible to be conceived of as merely an arbitrary activity. Thus Francis Bacon lauds "pura illa et immaculata scientia naturalis, per quam Adam nomina ex proprietate rebus imposuit."(167) Moreover it was an ancient and prevalent belief that Adam was not only possessed of Universal Knowledge but committed much of it to writing, and such books might not be beyond all hope of recovery. Thus Evelyn writing on the antiquity of Sculpture in the mid-seventeenth century declares of Adam: "For that there were several books about (some whereof had been long since read in the Primitive Church) bearing his venerable name; as that which Epiphanius and others cite....we have no reason to contradict: and Th. Aquinas in his treatise de Ente et Essentia speaks of a volume of plants described by Adam: and there are Traditions of a whole Natural History, with several other works of this most learned of all Men living, as Suidas doubts not to call him....though whether these Books of his were so miraculously found out and preserved by the renowned Trismegistus we leave to the more credulous," he also mentions that "the Aethiopians are said at this day to glory much in possessing the Books of Seth and Enoch."(168) (The "Book of Enoch" Dee believed he had secured, in an unknown tongue by dictation of the angels; Pico had gloried in possessing in Chaldean the works of Cham (Zoroaster).) Similarly Sherburne in 1675, puts Adam in his list of famous astronomers and mathematicians "the Book which goes under the titel of Liber Creation is being owned for his."(169)

It was thus without doubt that Adam was familiar with written characters; the question of whether these, and the tongue he spoke might not altogether have perished was resolved, or rather avoided, by postulating a later revelation involving the Hebrew letters. A work on alchemy Dee much prized and has interleaved with pages of his notes on it, makes wide use of the Cabala on the grounds that (it has just reproduced the Hebrew alphabet) "Concessi enim fuere supradicti caracteres Moisi in Monte Synai a Domino aeterno omnipotenti."(170) It was argued that since God himself wrote the tablets they probably bore some relation in their characters to that in which his own Book, of which there were various scriptural mentions was written, and texts such as that no jot or title of the law should pass away, the "jot" being interpreted as meaning the "iod," were pressed for supporting evidence. The Sepher Jetzinah describing the creation declares dogmatically "Viginti duos literass culpit, ponderauit transmutauit, composuit & creavit cum illisomnen animam creatam & creaddam. Viginti duae literae sunt sculptae in voce, incisae in spiritu, collocatae in palatione" etc.(171)

XI. The Cabala claimed to be the second and secret part of the revelation made to Moses (172), after this it had been preserved in the memories of successive generations through whom it had been handed down solely by word of mouth, and not till very late, and then not fully had it been set down in writing. This was one of the many aspects of the doctrine which made a special appeal to Dee's particular habit of mind. He seems always to have been inclined to value that knowledge most highly that was possessed by fewest men. His secretive methods of composition and transmission of his thought is largely responsible for the small incidence of survival of his many works; those particularly which he thought original or to have made an advance on earlier knowledge have mostly perished. That the Cabalah was the genuine fruit of an oral tradition, passed down through generations of the elect from the time of Moses, was to him the reverse of improbable; his own published works or those he designed for publication were too often only the fragmentary suggestions of the knowledge and opinions he would pour out in private exposition; his Monas was designedly obscure so that its full meaning could be only painfully deduced and this only by those already adept in what it spoke of. It was believed also that Plato had taught a secret doctrine orally, and that this had been carefully guarded lest it fall into the hands of the vulgar, for this was in effect what the second Epistle of Plato had stated; in replying to a question of Dyonisius who had claimed to know the "secret" of Philosophy, it insisted that, if anything were put in writing on such matter, it must be thoroughly enigmatic in expression: "I have never written on these subjects. There is no writing of Plato's, nor will there ever be; those that are now called so are the ideas of an idealized and youthful Socrates." Similarly the Phaedrus had said "He who thinks then that he has left behind him any art in writing and he who receives it in the belief that anything in writing will be clear and certain would bean utterly simple person and in truth utterly ignorant of the prophecy of Ammon if he thinks written words are of any use except to remind him who knows the matter about which they are written."(173) This idea was a familiar feature — and therefore more credible — in many other fields; particularly was a secret oral transmission a commonplace of alchemical lore: Norton in the fifteenth century says that alchemy is:

> A wonderful Science, secrete Philosophie
> A singular grace and gift of th'almightie
> Which never was found by labour of Mann.
> But it by Teaching or Revelacioun begann...
> No man could yet this science reache
> But if God send a Master to him teach:
> For it is soe wonderfull and soe selcouth
> That it must needes be taught from mouth to mouth."(174)

Similarities between cabalistic and Platonic doctrines, such as that of creation by a series of emanations in the Sephir Jetzirah, and the account in the Timaeus or Proclus' construction of the world in the Elements, or Plotinus' by successive privations of the hyle, leant support to the conviction that Dee seems to have shared with many others that Moses might be regarded as the original source of Greek philosophy (175). For the correspondences to be observed were held to be only explicable (if a separate revelation were not to be postulated) by direct transmission — or by theories of the truth common to all men by nature or by constant infusion from the divine. Such a hypothesis, that the Greeks preserved a Mosaic teaching, not fully available elsewhere, lent a new and authoritative dignity to their works, which might indeed be considered essential if they were to be fully accepted and much weight put on them, for, as a little book which Dee's acquaintance Thomas Twyne, translated, asks bluntly "who will believe that Aristotle or Plato did knowe anythinge concerning the creation of the worlde, whereof Moses was ignorant: who first received the thinges which he wrote by most secret revelation from God."(176)

In addition to the many particular tenets of his philosophy that Dee could find reflected in, and corroborated by Cabalistic teachings, it may be noted that Dee's extreme piety was of the type that is drawn to seek out great mysteries in the minutiae of Scriptural textual criticism, more especially so when what he found in the text could be given some form of numerical expression; such items as chronologies and genealogies seem to have had an inherent fascination for him. What we possess of his work on Solomon's Ophirian voyage show it to have been a huge

compilation of deductions from a few biblical passages; he decides on the exact navigational course of the journey and the time occupied in each stage, the number, type, tonnage and freightage of the vessels, their complements and the functional divisions among these and the numbers allotted to each task, the amount of victualling necessary and so forth, and to do this he seems to have thought was not merely of historical but of theological importance. The Cabalah which exalted every word of the scriptures to an ungaugeable level of significance, supplied Dee with authority and instruments for an occupation which had always a fatal attraction for him. Pythagorean numerology was an accepted study. Application of it to scriptural exegesis had been made by the fathers on occasion (177). But the Cabbalah suggested ways of extracting even more numbers from the Hebrew text and new ways of interpreting them. Certain passages seemed indeed to confirm clearly the accuracy and applicability of cabalistic method (thus only one servant of Abraham's is mentioned by name, but the numerical value of his name is equal to the total of servants Abraham is recorded as possessing). Therefore even apart from the many places which produced difficulties, or seemed pointless if accepted in a more obvious and literal sense, to take any of the Bible solely in this way seemed to be a slighting of the wisdom of God proferred to man (the four levels of literal, moral, prophetic and anagogical meaning in the scriptures was in any case a hoary commonplace), and the words considered as simple communication through conventional language were to be regarded as being, as the Zohar described the text "no more than the vestments and drossy coverings of a purer revelation."(178)

If Dee's obsession with the harmonies of pure number was at worst a harmless if unprofitable exercise, though one which had always a remote hope of producing some discovery of mathematical value, his parallel obsession with treating words and signs in this way involved him not only in much useless and arduous labour, but when he fell in with Kelly, the undoing of his life and thought was chiefly due to such an unrelaxing quest after angelic or divine names, which would be identical in power, perhaps in essence, with what they stood for. Created things Dee at times regarded as merely particular exemplifications of words and numbers, and came to the paradoxical belief that the purpose of things was merely to designate their appellations. In the Cabalah power of the word was inestimable. The opening of the Sephir Jetzirah proclaims that the mechanism of creation was "by three forms of expression, Numbers, Letters and Words" (179); in the Zohar, the first hypothesis of God is the "Word," from which the material world results, previously the "word" having been only a latent potential known as "Wisdom." "La loi qui a preside a la langue des Hebreux" writes "Papus" — a recent Cabalist — "est la meme que celle qui a preside a la creation de l'univers, et connaitre l'une c'est connaitre implicitement l'autre. Voila ce que tend a demontrer un des plus anciens livres de la Kabbale: La Sepher Jezirah (180).

"La theorie de la Kabbala pratique" Papus rightly observes, "se rattache a la theorie generale de la magie; union de l'idee et du symbole dans la Nature, dans l'homme et dans l'Univers. Agir sur des symboles, c'etait agir sur des idees et sur des etres spirituels (anges); de la, tous les procedes d'evocation mystique."(181) This theory is much more widespread than the strict Cabalistic form with which it corresponds; it figures prominently in the writings of many of those who chiefly influenced Dee's thought; indeed it seems to have been specially frequent in works of those largely interested in the natural sciences and holding at the same time Platonic theories about the activity of the soul and the a priori nature of certain forms of knowledge and appears as an almost invariant and important feature of the general syntheses such thinkers offer of the construction and operations of the universe. Kraus has presented this theory as it appears in Al Jabir's system; thus, "l'affirmation" he translates "que (le langage) est du a une institution et a une convention et qu'il n'est qu'un accident est fousse — car (le langage) est une substance, (il est) d'origine naturelle ( ) et ne derive pas d'une institution ( ) mais d'une intention dan's l'ame. Car les actes de l'ame sont tous substantiels....Les lettres memes qui forment la `matiere' du discours, sont une creation de l'ame, et partant substantielles."(182) Alkindi, from whom both Roger Bacon and Dee borrow heavily on this and other matters, subscribes to a similar theory; words are acts of the soul, and like all else emit rays producing action at a distance, these rays being the mechanism which holds all things in the universe in close interconnections. It is a subject Bacon recurs to frequently. "For such great virtue can consist in words that no mortal can trace it out." The Rational Soul has power over and controls all that is below it, "but its especial action is

the word and therefore the saints always performed their miracles by pronouncing words." He discusses how these should be formed to be effective instruments of magic, since the soul "has especial need of words formed efficaciously and by design." He also discusses how the letters of the Hebrew alphabet "had significance respecting the ancient people, and how they show the number of centuries through which the state of that race passed as regards its different periods and ages, in accordance with the special powers and potencies of the letters." The Greek and Latin alphabets Bacon maintains may also be put to the same use — Dee used them both without scruple in the Monas and made to reveal the future fortunes of the Greek and Latin churches (183).

Massetani compares the function ascribed to Hebrew letters in the Cabalah to that of the Platonic ideas (184), and indeed the general doctrines of the Cabalah could be easily adapted to take on a "Platonic" form and this more especially in that it was rather as a source fertile in suggestions than as a strict body of independent doctrine that the Renaissance in general accepted it. (Thus Paracelsus felt free to construct his own Cabalah, which though it embodied a few selected elements from the original, bore as a whole little resemblance to more usual forms; Dee's use of it also in the Monas would appear relatively free and personal.) Such an adaption rather than the Cabalistic textual interpretation connects it with the strong Lullian current detectable in the sixteenth century (185), and though the de auditu Kabbalistico, sive ad omnes scientias introductorium is almost certainly spurious(186), Lull's thought and logical method were largely interpreted and adapted by Renaissance scholars to bring them into accord with the doctrines of this work. Lull — who with Reuchlin and Agrippa perhaps the three most prominent among the writers Dee studied (including Pico, Archangelo de Burgo Nova, Cheradanus, etc.) who contributed to his views on the Cabalah — had attacked Aristotle declaring his metaphysics to be a juggling with barren categories and his morals to be based on ideas perceived through the senses; he himself wished to found a logic and a mnemonic system which should not be composed of abstractions or mere psychological rules for assisting the memory, but instead he aimed to tabulate a set of fundamental conceptions in which all present conceptions would be comprehended and out of which all future ones could be constructed. Their symbolic representation would also not be merely arbitrary and conventional (and sixteenth century "mnemonic" works such as Bruno's which have usually a metaphysical basis professed similar aims). His belief in the possibility of doing this could be related to cabalistic teachings, and to the position of the De audita Kabbalistico which describes how the mind is able to attain an intellectual realm of abstract truth, at which level words can be used not only to reveal the nature of things but to control them; though it is the knowledge rather than magic that is stressed. "Dicitur haec doctrina Kabbala" the pseudo-Lull writes, "quod idem est, secundum hebraeas, ut receptio veritatis cujus libetrei divinitus revelatae animae rationali....Est igitur Kabbala habitus animae rationalis ex recta ratione divinarum reru cognitionis. Propter quod apparet est de maximo etia diuino. Cosequutiue, diuina scientia vocari debet."(187)

Reuchlin was, as the pseudo-Lull was not, a profound Hebrew scholar. In his two dialogues he analyses a multitude of Hebrew terms into roots, syllables and letters and expounds them (it is from this and similar sources that Dee probably takes his otherwise seemingly purposeless habit of often giving the Hebrew equivalent for any concept he considers of mystical importance — thus after speaking of the firmament he adds "This is that, which in Genesis is called Ha Rakia. Consider it well."(188)) But Reuchlin also adapts the Cabalah's teachings fairly freely to his own purposes. Thus the ten degrees of knowledge, obscurely spoken of in Cabalistic writings, he equates with an elaborated form of "Platonic ascent," which he explains thus. Man is composed of the dust of the earth, and the breath of life "et spiraculo vitae p ditus, sapienter amet divina, producatque terra animam uiuentem ad speciem suam atque propriam uidelicet illam peculiarem Ideam, non brutorum, non plantorum, non lapidum aut lignorum, sed ab ore dei natam, & in faciem eius divino spiritu afflatam mentis suae ipsam illuminationem. Hec illa est que paulo ante a nobis vocatatur deificatio, cum ab obiecto praesente per medium suum exterior sensus in sensionem interiorem, & illa in imaginationem, & imaginatio in existimationem, & existimatio in rationem, & ratio in intellectum, & intellectus in mentem, & mens in lucem quae illuminat hominem, & illuminatum in se corripit."(189) It may be observed that though wedded to a neo-Platonic psychology, the Cabalah might in one part of its theory of the word, as a necessary unit of

meaning, and the same for all men, approach the Aristotelian view of the basis of language. (Indeed Reuchlin has no objections to raise against Aristotelianism or syllogistic reasoning if accepted as adequate only within a limited sphere.) A hint of this is perhaps detectable in the latin verses Dee contributed to a Welsh work of Henry Perry in 1594, where he seems to suggest that all languages (he mentions Hebrew, Latin and Welsh) have a basic structure in common, and are thus keys to each other (190).

Agrippa's treatment of Cabalistic theory lays much greater stress on magic than either "Lull" or Reuchlin. He divides his work into three parts dealing chiefly with natural magic, number, and divine names — or ceremonial magic, to correspond with the three worlds. God, he argues, gives names to things, for Christ said "your names are written in Heaven." The act of imposing a name, even by man, if done under proper astrological and magical conditions, establishes a relation between it and the thing it signifies, whose efficacious virtues it then possesses independently. Names (he borrows from Alkindi) being acts and powers of the soul, are substantial; they emit rays, which is why they remind men of things they stand for, since these rays produce correct and lively images in the mind. The Platonists maintain, he says, that the force, the very life of a thing, is concealed in its name (191). But Agrippa, whose work contains little that is original to him — it is rather a vast compilation of fragments of theory and information from a wide variety of sources, attaining a sort of unity by the ingenuity of the arrangement — though he exercised, along with those previously mentioned, an extensive and continuous influeNce over Dee throughout life, is more properly relevant to a later discussion on Natural Magic.

XII. Dee's enthusiasm for mathematics, which he regarded as the noblest of the sciences — after quoting Plato's opinions on it and mentioning its use in scriptural interpretation, he exclaims in the Preface; "No man, therefore, can doute, but toward the atteyning of knowledge incomparable, and Heavenly Wisdom: Mathematical Speculations, both of Numbers and Magnitudes: are meanes, aydes and guides; ready, certaine, and necessary" (192) — was not unrelated to his interest in the Cabalah; and this because his attitude towards it, and the fundamental assumptions he made about it, required only a slight shift in direction — so that they now applied to a somewhat different set of entities — to provide an equally cogent justification for Cabalistic theory. Thus mathematics was a form of expression and in one sense a language as much as the Hebrew, and if it seemed more truly founded in nature and universal than speech in which a large element of the conventional had to be accepted as entering, this could largely be offset by the privileged position that Hebrew could be held to have been revealed as possessing in relation to God. To postulate that a system of expression such as Mathematics — and one self sufficient in the sense that its objects of reference seemed immaterial and natural to the mind, while it was governed by a logic, or syntax, that allowed it to be fully developed by pure deduction — to postulate that such a system remained necessarily true in so far as its conclusions applied to the external world — and this in an age when any Kantian solution based on the supposition of subjectively inevitable, and therefore imposed, forms of knowledge, was undreamed of — appeared to Dee and others to imply, though perhaps sometimes such a claim might be rather a consequence of this prior belief, that the universe had been constructed by an intellect working according to, or via the instrumentality of, such a system of expression. Mathematics was therefore at once the participating framework of the world, and its transcendent pattern, and its parts — numbers, figures, or relations — were frequently ascribed ontological status within the universe, and regarded as certainly possessed of spiritual significance or (as in practical magic or ceremonial theurgy) some degree of efficient power, in so far as they were thought to be original ideas or instruments of God. Very similar claims were made by the Cabalah respecting Hebrew words and the letters of its alphabet. The views of the Cabalist and the Platonic mathematicist may therefore be considered to approach each other in that each depended on the acceptance of the belief that a particular "intellectual" symbolic schematisation, existing in its own right with independent validity, dominated and controlled the physical world, to which it was logically prior, and the essence, the reality and true pattern, of which it was able to reveal to the student.

There were many other reasons why Dee might feel the two subjects intimately related. The Cabalistic analysis of words and letters and the transmutations they subjected these to by the aid of numerical equivalencies, were governed by formal rules, that might be supposed akin to mathematical procedure, and might well tempt one fascinated by these, at least to investigate the Cabalah. But more important was the conspicuous accord between the spirit of the Cabalah and traditional academic instruction in the arithmetic of the quadrivium, which Dee probably still encountered in his studies at Cambridge. This still closely conformed to Boethius' exposition; it did not lay down rules for calculation but concentrated solely on the study of the properties of particular numbers, and ratios; and this frequently accompanied by discussions on their moral or theological import. Its method stemmed from the ancient mathematicians, such as Theon and Nicomachus, who had been considered to be links in a Platonic "golden chain" (Proclus indeed believed "he possessed the soul of the Pythagorean philosopher Nicomachus" (193)), and who in their works had largely neglected any attempt at demonstration, but contented themselves with enunciating various disconnected principles and illustrating them. Such a process, if it were to avoid a charge of complete triviality, had to claim metaphysical import, and the view of number of Nicomachus' Introduction--that it made up the essence of the phenomenal world, and existed as the archetype of all things in the mind of God, was consequently a persistent accompaniment of this study; it was reproduced fairly exactly for instance in the discussion of arithmetic supplied by Cassiodorus, Capella, Isidore, Bede, Alcuin, Gerbert, Hugh of St. Victor, etc.(194) But early in the sixteenth century a new school — which has been termed "algorist" to distinguish it from the older, "abacist" arithmetic — makes its appearances, its productions, which were chiefly designed to be of assistance for commercial practises and which also promoted the wider use of Hindu numerals (195) concentrated on the teaching of rules for various computations. Some of these,

such as Tunstall's (1522), Recorde's (1540) which Dee himself was later to revise and Stifels (1544) — which later editions of the Grounde of Artes refer to and employ — and Gemma Frisius (1540) (that of Frisius on the Continent and that of Recorde in England both ran through multitudinous editions in the course of the next hundred years), would have been available to Dee at this period of his life. However it is notable that, with one or two exceptions these works betray no more concern for "proof" than do those of the "formal number" theorists of the older school; at best they offer mechanical devices for testing the correctness of results obtained (196). Dee from his period at Louvain onwards had close connections with the leaders of the new school, and may even have received some instruction while at Cambridge from Recorde who was said according to Wood to have "publicly taught Arithmetic and the grounds of Mathematics, with the art of true accompting, all which he rendered so clear and obvious to capacities that none ever did the like before him in the memory of man."(197) However the exponents of the new school of arithmetic neither excluded nor opposed the older teachings, in general, which frequently appear as important features of their thought elsewhere. Dee's Monas for instance is an exercise in the investigation of the "symbolic" properties of particular numbers, and appeared not long after his revision of Recorde. Thus Dee inserts in the Euclid in addition to his more strictly "geometrical" expansions of the text, several passages of this kind, there is a paean to the virtues of the five regular solids for instance, for Dee declares, "They are as it were the end and perfection of all Geometry, for whose sake is written whatsoever is written in Geometry....The knowledge of them containeth infinite secretes of Nature. Pythagoras, Timaeus, and Plato, but them searched out the composition of the world, with the harmony and preservation thereof, and applied these five solides to the simple partes thereof...." (198) — this last enthusiasm is perhaps reflected in the production of what is itself a purely geometrical treatise on these bodies by his pupil Digges, who elsewhere shows himself concerned almost solely with the most practical aspects of applied mathematics (199). Mystical applications of their science, extensions of it to the demonstration of theological dogma, continue to be made on occasion by orthodox mathematicians of the seventeenth century (200). Galileo of course entirely rejects such number symbolism and it is significant that he makes Simplicius, the Aristotelian (who presumably has mastered the usual contents of quadrivium), who displays an invincible obtuseness in the face of the simplest piece of mathematical reasoning, profess his belief in it. But the close connection it was still thought to have with all mathematics, is shown by Galileo then being compelled to evolve a tortuous explanation of how since he admits to holding a Pythagorean metaphysic, he can account for the Pythagorean's attention to numerological fantasies of this kind (201).

More important than any of the original contributions to mathematics, made in Dee's age, perhaps, was the work then performed in resurrecting, studying and diffusing ancient texts — a subject on which Ramus' correspondence with Dee has been noted, and for which Dee always displayed considerable enthusiasm. This work which still appeared of great scientific importance in the succeeding century (202), directly contributing to many of the new "discoveries" then to be made even when these appeared superficially strikingly dissimilar to Greek achievements (203). Accompanying these revivals, and stimulated by them, is also to be observed in Dee's age a tendency towards the synthesication of mathematics, a constant attempt to unify them under some general logical procedure; this shift in emphasis or displacement of attention from the objects — the contents as it were of mathematics to the "form" and method, contributed to the rise of algebra, which most purely exemplifies such a logical system, but it was an endeavour conducted in the sixteenth century largely under the spell of the Euclidean methods. The general lack of demonstration in the new algorist textbooks has been noted previously, when thought necessary it was frequently borrowed from and the process considered almost a part of, geometry (204). Especially was this the case with any problems in which irrationals might figure, as these were conceived of as being more properly magnitudes than numbers; for, while they could not be given complete expression in numerals, they might in many cases by geometrical constructions be exactly represented as lines (numbers being held to be the province of discrete and length of continuous quantity)(205). But the Greeks had rigidly separated arithmetic and geometry and many in Dee's time continued to insist on their complete separation (206). Dee on the other hand seems to have wished to establish closer relationships, and show the unified structure maintaining between the

various branches of mathematics. Thus, under the title "Note M. Dee his chiefe purpose in his additions" in the English Euclid (207) Dee explains, "My entent in additions is not to amend Euclides Elements (which nedeth little adding or none at all) but my desire is somwhat to furnish you toward a more general Art Mathematical than Euclides Elements (remayning in the terms in which they are written) can sufficiently helpe you unto." In accordance with this object he appends to Book II demonstrations of all the prepositions it contains in arithmetical terms, from a treatise by Baarlaan; he expands extraordinary care in setting out the fifth book, in which the connection between geometry and arithmetic is most clearly established, and the procedure employed equally applicable to both usually omitted as irrelevant or over difficult, this book is here claimed as "a chiefe treasure and a peculiar iuell much to be accompted of" and recognised as fundamental to the knowledge of all the mathematical sciences (208); similarly Dee points out how knowledge "of that more secret and subtill part of Arithmetike, commonly called Algebra" is essential to the complete understanding of the tenth book (209).

It was, however, geometrical procedures that still dominated ideas of mathematical logic in the sixteenth century. This was so for instance in the case of algebra, a science Dee describes along with the science of proportions, as one of the most divine and secret parts of mathematics. Men, now he declares in the Preface, "have found out, and atteyned to the very chief perfection (almost) of Numbers practicall use. Which thing, is well to be perceived in that great Arithmeticall Arte of Aequation: commonly called the Rule of Coss, or Algebra....This Rule, and Arithmetike of Algiebar, is so profound, so general, and so (in maner) conteyneth the whole power of Numbers Application practicall: that man's witt, can deale with nothyng, more proffitable about numbers: nor match, with a thyng, more mete for the diuine force of the Soule (in humane Studies, affaires, or exercises) to be tryed in."(210) But although some striking discoveries were made in Algebra, during Dee's early life (in 1544, for example, Cardan published Tartaglia's solution of the cubic, and Ferrari's solution of the biquadratic equation) its development was crippled by a cumbrous and obscuring notation, and it was not until after the improvements of Vieta and Harriott at the end of the century that it emerged as properly an independent, generalised science. The Diophantine tradition moreover (Dee himself was able to study Diophantus' own work, till his day believed lost, when he was lent a recently discovered manuscript) offered merely a large number of manipulative methods for dealing with a multitude of particular cases. Hence perhaps Dee's emphasis on its practical rather than general methodological value. However algebra could be made, as was no longer requisite or generally possible after seventeenth century innovations, capable of geometrical representation, and was usually conceived of in such terms (221). Thus for example, the solution of equations, a problem in the reduction of complex to simple terms without change of value, was in principle the same as the comparable geometrical process, then considered of such importance, which Dee discussed in his notes to Euclid, and which was one of the operations the "geometrical compass" — which Galileo invented and published an account of in 1597 — was designed to assist: the reduction of irregular to regular figures, and of several regular figures to a single one in its simplest form Arithmetical and algebraic demonstration when attempted looked for inspiration chiefly to the 2nd, 5th and 10th Books of Euclid (for the divine doctrine of proportions, methods of manipulating various progressions, provided the pattern for the majority of operations and types of calculation then in use). On a simpler level, multiplication was conceived of as constructing a rectangle from two given lines, division as the construction of a third line having a given ratio to two other lines, the extraction of roots as the finding of a square equal to a given rectangle, or the quadratic equation in its normal form as the addition of a square of unknown size to a rectangle having one side equal to it, the other being the known "coefficient," the area of the whole figure being known; and so on.

The relationship of algebra to geometry and the logical primacy of the latter, moreover had consequences of a more purely philosophical kind. Thus Boutroux has defined two chief movements in the development of mathematical thought, in which endeavours can be distinguished as conducted under the respective influences of these two sciences (212). The one, existing unopposed and rapidly achieving maturity in Dee's age, "se borne d'abord a constater," and approximates to the outlook of Plato, it views the world around with mathematical eyes, to discover its numerical "harmonies," it succeeds in synthesising quantity and figure and reuniting in

principle geometry and arithmetic. With the rise of Algebra a revolution takes place, already apparent in Descartes' approach (213) "De contemplative qu'elle etait, la science se fait constructive," from simple elements it now aims to construct more and more complex assemblies by its own industry (the mathematician inventing and building, as it were his own science) and "son but principal n'est pas de connaitre des faits nouveaux mais d'accroitre sa puissance creatrice et ses ressources de constructeur en perfectionnent de plus en plus ses procedes." This ultimately has as a consequence that of the two categories of mathematical procedure — the initial selection of ideas, and demonstration — the first which had hardly been of any prominence, since in the "geometrical" period, becomes of increasingly preponderant importance, and the Euclidean singleness of form, and the earlier acceptance of a necessary and integral connection between ends and methods, problems studied and procedure applied to them, is abandoned. But in the sixteenth century algebra was regarded as a rule or collection of rules (214); for Dee, despite his praise of it, it remains "The Great Art of Algiebar," and he employs "Art" here in the sense of technique and in opposition to "science," a status he allows to arithmetic and geometry. It could not indeed be regarded, it was supposed, as an objective science on a level with these other two, since it could not, unlike them, be
defined by its matter, it was a technique of calculation void of peculiar content. In this distinction lies the philosophical importance of the relative status of the branches of mathematics in the sixteenth century, as it points directly to one of the reasons why mathematicians of the day such as Dee so strongly tended to embrace a Platonic realism. For the dominance of geometry and arithmetic over algebra promoted the conception of mathematics as observational rather than creative, the objects it dealt with, the number series, or points, lines, surfaces, solids and spatial relations, seemed to be provided in advance, and the science did not invent but examined and explored; and again the intellectually defined space of Euclid, exhaustively described by a priori methods, since it seemed to be so uniformly and exactly equivalent to "physical" space, seemed to suggest that the universe might be altogether mathematically intelligible, and lent indirect support to the speculations of the Timaeus on the constitution of matter, or to the geometrical atomism which the recently discovered works of ancient mechanical writers such as Hero and Philo, in their discussions of pneumatics, presented.

XIII. Of the applications of mathematics, its immediate practical fruits, perhaps that traditionally supposed most directly connected with it, was the art of making machines, often spoken of as "mathematical magic." Dee's construction of a device coming under this heading, the Scarab for the Trinity Greek play has already been noted. He maintained always an interest in mechanical inventions; but though he foresaw and announced enthusiastically that great material powers could be won over nature by technical development in an age when machines were few and crude, and economic incentives for discovery apparently lacking (215), his sympathies remained entirely opposed to the type of view for which Francis Bacon became so famous as a propagandist, and which Boylein the mid-seventeenth century ascribed to the Royal Society, referring with approval, to "our new philosophical college, that values no knowledge but as it hath a tendency to use."(216) Nevertheless Dee's emphasis on the potential utility of this science contrasts strongly with that of the ancient writers whose works were stimulating interest in it at the time (217). The writings of Philo and Hero are of the same type as that lost work of Ctesibius which, Vitruvius said, was full of many things "quae non sunt ad necessitatem sed ad deliciarum voluntatem" (218); with the exception of a few for weight lifting or military purposes, ancient mechanical inventions appear as almost wholly directed to amuse, astound or deceive a spectator (the name the art earned inconsequence, Dee continues to employ, when he treats in the Preface of "Thaumaturgike" among the "Arts Mathematicall," and is at pains to purge it from the imputation of Sorcery (219)). Throughout his life Dee threw off from time to time casual technical inventions; they were usually prompted by some specific need, and in this sense "occasional," and though he may speak of them with pride, he seems to have taken little care for their survival or dissemination by recording full descriptions of them, and perhaps regarded them as chiefly important in providing palpable evidence and illustration of those general cosmical mathematical theories that had led him to attempt them. His acquaintance, Robert Norman, an experimentally minded instrument maker, could grow lyrical about how successful empirical practitioners were "caried and overcome with the incredible delight conceived of their owne devices and inventions," (220) but for Dee such exercises were far from being the most important aspect of the knowledge he sought; the possibility of their performance would inevitably accompany its attainment, but in the "scale of being" they represented a decline from pure mathematics, a privation of its sphere of reference, and not the ascent from it, which Dee held the mind capable of making and to be most worthily employed at when essaying. (Nevertheless his unvarying use of "Mercury" as the proper symbol of intellectual truth, and the soul's activity, of course carries with it a subsidiary suggestion of practical application (221).) Over-attention to such practises might carry with it a tendency to approach problems in mathematics in a way Dee felt to be inadequate and dangerous. Archytas we are told, who was the first to attempt the systematisation of mechanics, was also the first "to employ mechanical motion in geometrical construction," and by such methods duplicate the cube (222); or again, Iordanus Nemorarius, in the thirteenth century, had claimed a successful trisection of the angle by allowing a sliding and rotatory movement to a graduated ruler; both he and Campanus, following the usage of some Arab mathematicians had not scrupled to introduce a notion of the parts of a figure in geometrical procedure. Dee discusses such methods in his Preface, and more fully in his notes, to Euclid; his position is strict but intelligent and unpedantic; he himself is throughout fertile in similar suggestions — for the determination by physical methods of the proportion of a square to circle when the side of one equals the diameter of the other and so on, but he firmly excludes them from the sphere of geometry proper, which he insists must proceed only by demonstration, and never rely on intuitively plausible illustration, and which must limit its constructions entirely to what can be achieved with straight edge and compasses (nor may these last even be legitimately transferred from one place to another, and remain open). The mechanical devices, for attaining approximate results he adds by way of footnotes, for a variety of extrinsic reasons. They are designed to assist artisans in performing necessary constructions in connection with their crafts where only a certain degree of accuracy is required; and, when not of so direct an utility, are intended to convince the artisan of the applicability of mathematics to material things, since he may approach, ever more exactly and as closely as he pleases by increasing carefulness in performing the suggested experiments, to the result arrived at by previous reasoning. Dee is careful to point out that such operations must not be considered as superseding or as an adequate

substitute for the theoretical procedure of Euclid — and demands of his readers, however practical their interests, that they only go on to them after mastering the logical demonstrations.

Dee's experiments, his excursions into particularities, his useful or spectacular inventions, he engaged on only as illustrations of his more abstract doctrines, to entertain or impress, on occasion, those whose patronage he sought, or sometimes when so requested to meet some specific need, that might be of advantage to the commonwealth. A sidelight on the relatively early, fixed direction in his views is provided by his notes and underlinings in his Greek and Latin Euclid of 1557; in Gracilis' preface, which argues that numbers are the "rational parts" of things, he particularly remarks (in addition to Archimedes' claims for the powers of mechanics) the passage "Sic ergo censuit Plato, sic Aristoteles sic deniq; philosophi omnes, Geometriam ipsam cognitionis gratia exercendam, nec ex aliquo usu externo, sed exrerum intelligentia aestimanda esse."(223) Dee compared himself once, in a well-known phrase, to Aristotle (requesting Elizabeth to be a second Alexander), but it was Archimedes, whose exploits, though almost fabulous in kind had been voluntarily restricted, undertaken only reluctantly, that he seems to have regarded as in many ways the true type of the investigator of phenomena, and searcher after knowledge, and himself held, probably with conscious acknowledgment of the correspondence, similar views on the purposes of mathematics to those which Plutarch ascribes to Archimedes (224). The editio princeps of Archimedes' works appeared at Basle in 1544, but portions of them had been available in various sources since about 1500 (225); Dee's acquaintance Commandine composed a commentary on them, and Dee, in a translation in the Preface, claimed to be the first to give various propositions from the "statics" widespread circulation in England, a proceeding which bore fruit in other contemporary works. Dee's admiration was generally shared by mathematicians of the day; Cardan drew the wrath of Scaliger, who branded Archimedes a mere artisan, for giving him first place in his list of the great thinkers of the world (Aristotle and Euclid he placed second and third)(226). There is much justification for accepting, with little reservation, the frequently encountered descriptions of this period "the century of Archimedes." Seailles writes: "des le XVe siecle le reveil et le progres scientifique se mesurent a l'influence d'Archimede...Qu'Archimede ait ete l'initiateur de la science moderne c'est une verite de fait."(227) At the end of the century Galileo's original work may be said to have begun in many respects, his transition from statical to dynamic problems, for instance, at precisely the point where Archimedes broke off. Archimedes' approach, it is true — so lucid and inevitable when offered as a finished product, but entirely mysterious, because altogether unhelpful and unenlightening, as regards the manner in which he must originally — as opposed to his subsequent exposition — have conceived, and in fact arrived at the solution to problems (228) aroused wondering scientists such as Dee and Pedro Nunez to speculations on the Greeks' possession of some secret method of analysis that had never been divulged. Nevertheless Archimedes' application of apparently entirely deductively founded methods of demonstration to subjects hitherto considered remote from the sphere of pure geometry, and offering a complete contrast to Aristotelian treatment of the theory of the lever or general method in the Mechanical Problems, was to a large extent responsible for the effect now produced by his writings — they set a model which numbers of works on a variety of sciences followed (229).

XIV. The general picture Dee presents to us in the earlier periods of his life never changes greatly. Although always professing a desire that fruits of his studies might sometime be applied to the common good he is primarily a secret man ardently pursuing secret knowledge (230). Trithemius, for whom he had excessive admiration, had written to Agrippa on being shown the Occult Philosophy that he should "speak of things public to the public but of things lofty and secret only to the loftiest and most private of your friends."(231) In accordance with such sentiments, Dee, however generously open in personal intercourse, reserves his work from publication, or publishes in the most veiled and obscure terms at his disposal, in the tradition of the great alchemists (232). (Stressing this side of his nature — which appears clearly in his Monas only serves to emphasise by contrast, the considerable prejudices he overcame later, when in the Preface and other writings he championed the cause of the vernacular, particularly as a medium for scientific and philosophic texts and attempted to assist popular instruction.) However at the same time he invariably and clearly asserts the general position that laws and harmonies are discoverable in nature by observation and experiment which reveal God directly. A frequent and important Hermetic dogma was the insistence on an original fall from grace which deprived man of the perfect wisdom, which by nature he was capable of, and which, however, he might still to varying extents recover and return to. Dee would seem at times to have accepted this position, and regarded all new knowledge only as a rediscovery; something proper to the soul, which, in Adam, had possessed innately, or known as a matter of immediate experience, such truths as could now only be attained by exercise of reason and represented to the intellect in abstract formulae. Mathematics he held to be native to the mind, and nature he held should be studied quantitatively because its essence was mathematical, and the structure, in this respect, reflected truths in the mind of God; the mysteries nature concealed and which were to be sought out were theological statements in mathematical terms. Thus it has been observed that "For Dee the realm of natural philosophy had no sharply defined boundaries, in its farther limits it met the spirit world in a misty border region," and his deep interest in this borderland has obscured his achievements to late generations (233). But similar positions were almost forced upon many mathematicians of the day who wished to justify their own attention to their subject and maintain its fundamental importance in the fact of the only too common charge that, as Herbert of Cherbury phrases it, while in method it was admittedly the most certain of Sciences, yet its end and objects were "but ignoble in respect of others as tending only to the measuring of heights, depths and distances, or the making of some excellent engines and the like; all which are of so mean consideration, that they can be in no ways esteemed, as objects adequated or proportioned to the dignity of our souls, whose speculations reach much further."(234)