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SARTON, C.  
1955

## CHALDAEAN ASTRONOMY OF THE LAST THREE CENTURIES B.C.

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THE LATEST WORK of Professor Neugebauer on the astronomical cuneiform texts of the Seleucid period\* is so important and the field which it covers is relatively so new that it is worth while to devote a special article to it rather than a review. This is especially true because the work is almost impossible to criticize and yet it suggests a number of reflections and queries. Independent criticism could be provided only by another scholar working exactly in the same field, and I know of only two such scholars living today, the author and his assistant, Abraham Sachs. There are also a few scholars, non-Assyriologists, who have helped in the interpretation, such as the two Dutchmen, the astronomer, Antonie Pannekoek, and the mathematician, B. L. Van der Waerden. As to professional Assyriologists, they would be qualified to discuss, let alone criticize, this book only if they were sufficiently familiar with astronomy in general and Chaldaean astronomy in particular.

The work is a corpus of all the astronomical tablets written in cuneiform during the last three centuries before Christ. Some such tablets (about fifty) had been edited before by Franz Xaver Kugler (1900, 1907), by François Thureau-Dangin (1922) and by Paul Schnabel (1924, 1927); Neugebauer's corpus includes these older tablets with new material relative to them, but he has added some 250 new tablets. There are thus in all 300 tablets and fragments, more than half of which concern the moon, the rest the five planets. About one-third of the tablets come from Uruk,<sup>1</sup> the rest probably from Babylon.

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British Museum, as late as 1952, produced 60 more tablets. Others are still under ground or unrecognized in the museums and nobody could say how many more will eventually be deciphered. A corpus of 300 tablets, many of which are very elaborate, is more than sufficient, however, to illustrate the principles and practice of Chaldaean astronomy.

The majority of these tablets are what we would call today ephemerides, giving the positions of the moon from month to month for a single year, and also the position of planets at consecutive heliacal risings. Their purpose was somewhat the same as that of modern tablets, e.g., the *American Ephemeris and Nautical Almanac*, except that the Chaldaean astronomers were not interested in navigation. These ephemerides were published a little ahead of the time when they would be needed. Other tablets contain what Neugebauer calls procedure texts (*Lehrtexte*), because their purpose is ancillary to the main one; they do not explain the theory at the back of the tables, but the method of compiling them.

Many of the tablets are dated according to the Seleucid era;<sup>2</sup> others are datable by means of comparison with dated ones; relatively few are undatable. Two Seleucid kings are named: Antiochos III the Great (223-187 B.C.) and Seleucos IV Philopator (187-175), and one Arsacid (Parthian dynasty), Arsaces and Queen Piriustana (69-68 B.C.). The chronological range of the astronomical tablets can be ascertained quickly

\* *Astronomical Cuneiform Texts. Babylonian Ephemerides of the Seleucid Period for the Motion of the Sun, the Moon, and the Planets.* By OTTO NEUGEBAUER. 3 vols., quarto. Vols. 1 and 2, xvi + 511 pp.; vol. 3, 255 plates. Published for the Institute for Advanced Study, Princeton, N. J., by LUND HUMPHRIES, London, June 1955.

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from two synoptic tables placed in the frontispiece to vols. 1 and 2. They show at a glance the temporal distribution of the lunar tablets (from c. 260 B.C. to 49 A.D.) and of the planetary tables (from c. 230 to c. 30 B.C.).

Volume 3 contains transcriptions of the tables, that is, long series of sexagesimal numbers written in our style (e.g., 3, 35, 28 means 3 plus 35/60 plus 28/3600) with very few symbols or names of units. To the non-initiate (and this includes almost every Assyriologist) these tables are as hermetic as the cuneiforms themselves. The last 28 tables display photographs of selected tablets.

The editor of mathematical texts has the advantage that those tables are to some extent self-correcting, as they must be consistent. It is thus easier to detect an error (a lapsus of the original scribe or a misreading of the modern editor) in such a text than it would be in a literary text. This is of special importance for the making of "joins," that is, the putting together of tablets or fragments which the vicissitudes of excavation or business have carried to different repositories. Such joins are not impossible to realize in other fields, witness some admirable ones which Samuel Noah Kramer managed to clinch in the field of Sumerian mythology,<sup>3</sup> but they are more obvious and more certain in mathematics and astronomy.

It is not necessary to insist upon the difficulties of such decipherments; the patience and ability of palaeographers pass my understanding. Neugebauer was lucky in that many of the tablets are what we would call "fair copies," probably the final redactions prepared for the temple archives and therefore written as clearly as possible. The scribes in charge were very conscious of their responsibility and often added their names to the colophon. As far as the Uruk archives are concerned, the various scribes belonged to two families, Ekur-Zākir and Sin-leqē-unninnī; as the names of the scribes are recorded in the usual Semitic style "A son of B son of C," etc.; it is possible to construct the genealogy of those families (p. 14).

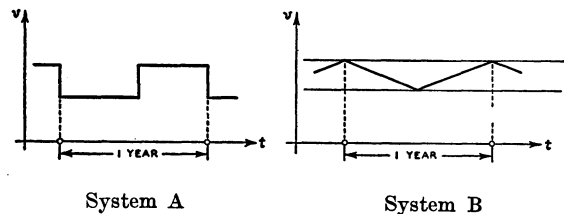
Given the tables and procedure texts, Neugebauer succeeded in discovering the mathematical methods used by the Chaldaean compilers and this is explained by him in his introduction (p. 28-40).

<sup>3</sup> S. N. Kramer, *Sumerian Mythology*, 140 p. (Memoirs of the American Philosophical Society, vol. 21, Philadelphia, 1944).

His explanations are clear but terse and could not be summarized without making them unintelligible. For him whose curiosity has been awakened, there is no alternative but to study the book itself.

The bulk of vol. 1 (p. 41-278) is devoted to the edition with commentary of the lunar tables. These tables were of particular importance because the Chaldaean calendar was (like the Jewish one) purely lunar; the main duty of the priests-astronomers was to determine the first visibility of the new crescent. The tables indicate a little in advance the time when the crescent could be expected and thus facilitated the task of the observers. The Chaldaean astronomers tried to determine in advance the times of conjunction and opposition (syzygies), of first and last visibilities and of eclipses. Their results were astonishingly good (except for eclipses); considering their elementary mathematical tools they could hardly have been better.

A good proof of their gradual sophistication is given by the fact that they used two systems of computation, A and B, the main difference between which is as follows: In A, the sun was supposed to move with constant velocities on two different arcs of the ecliptic; in B, the solar speed varied gradually throughout the year. The simplest definition of both systems is the following graph taken from Neugebauer's book (p. 41):



System B is more refined than A, but it does not necessarily follow that the latter is more ancient. A more refined method may have been used in one temple, while a more primitive one was used later in another temple. According to Neugebauer's patient analysis of all the lunar ephemerides, that is just what happened.

| LUNAR TABLES  | URUK | BABYLON |
|---------------|------|---------|
| System A..... | 2    | 61      |
| System B..... | 52   | 27      |

Now the Uruk tables extend from 231 to 151 B.C., while the Babylon tables extend from 181 B.C. to

49 A.D.; that is, the Babylon tables are largely posterior to the Uruk ones yet most of them are of the A type; the Uruk tables are more ancient and are almost exclusively of the B type.

The weakest part of Chaldaean astronomy is the one concerning eclipses and that is not surprising, because they neglected an essential element, the parallax of sun and moon. There are only three tables of eclipses, all in system B, two for lunar eclipses, one for a solar one. A tablet which found its way from Uruk to the Louvre in two pieces (no. 135; Louvre AO 6485 and 6487), contains an almost complete 18-year cycle of lunar eclipses. That tablet was written in Uruk in 190 B.C.

The most astonishing feature of the planetary ephemerides is that most of them concern Jupiter. There are 41 texts and fragments on Jupiter, and only 40 on the other four planets together. This puzzles me; Jupiter is more brilliant than Sirius, the brightest star, but it is less brilliant than Venus can be when it is nearest to us. Why were they so interested in Jupiter?<sup>4</sup> In this case, even more so than in the lunar one, the Chaldaean astronomers were not easily satisfied, and they made use of at least five different systems of computation (at least three variations of A, plus two variations of B). "Procedure" texts explain the methods and one of them relative to Mars tries to explain the theory behind them (no. 811a, pp. 381-90).

The following digression may interest orientologists who are not familiar with the history of science. Teachers of that history are still very rare because few universities or colleges can afford such "luxury," and only a very few universities have more than one teacher. This means that if he be conscientious he must try to cover somehow the whole history of science throughout the ages everywhere. It is paradoxical that teachers of political history are never expected to cover the whole ground; no president or dean would ask the same man to teach American history, and also the history of the ancient Near East, the history of the

Middle Ages and of China. That would seem stupid. And yet the historian of science is blandly expected to know the whole of history plus the whole of science—a pretty big order.

If he teaches ancient science, he must devote a few lectures to Egyptian and Babylonian science, and yet he cannot be either an Egyptologist or an Assyriologist; if he wishes to explain the development of science in the Middle Ages, he must devote many lectures to Arabic science, and yet he cannot be a full-fledged Arabist or he would be nothing else. The final result is that he is bound to commit errors. As far as Egyptian and Babylonian science are concerned, the worst and most common error is to treat them as if they were wholly anterior to the earliest Greek efforts;<sup>5</sup> that is just as foolish as if a professor of literature would deal with English literature as if it were wholly anterior to the American. Much of English literature is pre-American, much else is not. Some of the Egyptian and Babylonian efforts are very ancient indeed (second and third millennia) and definitely pre-Greek; others are much later. The Chaldaean tablets investigated by Neugebauer are very late indeed; some of them are almost as late as Jesus Christ, who is closer to us than to the early Sumerian mathematicians. Sumerian mathematics influenced the Greeks very deeply and traces of its prestige are still obvious in our own culture; the position concept in numeration, the sexagesimal system of numbers and its extension to submultiples as well as to multiples, its extension also to metrology, as is the case for the decimal system today. In the astronomical field, the early Babylonians bequeathed the notion of the Zodiac (twelve houses of 30° each) serving as a

<sup>4</sup> From the Babylonian point of view it was the star of Marduk, chief god of their pantheon. Hence, the Greeks called the same planet Zeus and the Romans, Jupiter. This does not answer the question, however. Why did the Babylonians associate that particular planet, which was not the brightest one, with Marduk? They were probably impressed by the extraordinarily long period of Jupiter, almost twelve years as compared with that of Venus (225 days). Yet Saturn's period is still much longer (29½ years) and they knew it.

<sup>5</sup> That error, I am sorry to say, will be much aggravated by the new classification adopted in the Eightieth Critical Bibliography → *Isis* (XLVI, 111-220, 1955) wherein all the Egyptian and Babylonian documents are put together under the heading "Preclassical civilizations" (p. 147-48). Now that is all wrong. Some of the Egyptian and Babylonian items are preclassical, many others classical or postclassical. Cuneiform documents continued to be produced until the first century after Christ, and demotic papyri until the sixth century, if not later. In other words, some of those papyri were written in our own Middle Ages.

Most books dealing with Egypt and Babylonia in general cover those cultures from beginning to end, hence to classify them under "preclassical" (whatever that may mean exactly) is very misleading. The only place where they belong should be labelled "Egypt" or "Mesopotamia" as was done in the old *Isis*.

frame of reference for solar, lunar and planetary motions, the main sequences characterising those motions, the variable durations of days and nights, the use of arithmetic progressions to describe periodical events, and the application of other arithmetical methods to planetary and lunar problems. Old Babylonian observations were used by Hipparchos and recorded by Ptolemy; some of those observations made it easier for Hipparchos to discover the precession of the equinoxes.<sup>6</sup> In short, the influence of ancient Babylonian science upon ourselves is truly immense; instead of saying as is often done that the roots of our culture are Hebrew and Greek, we should say Sumerian, Hebrew and Greek. On the other hand, Chaldaean astronomers have not influenced us at all.

In spite of the fact that Neugebauer inserted the word "Seleucid period" in his title, I am afraid that superficial bibliographers will be bamboozled by the words "Babylonian ephemerides" in the same title, for those words generally suggest hoary antiquity. I think it is better to say Chaldaean which means late Babylonian or Neo-Babylonian and does not risk causing any confusion. The term Seleucid is better for purely chronological reasons,<sup>7</sup> but is misleading in another way, for it refers to the Hellenistic government, while the ephemerides were compiled by native priests. The Seleucid empire was very heterogeneous; it was never as well organized and as strong as the Lagid empire in Egypt and its disaggregation was steady with few interruptions. The Seleucid rulers were the main champions of Hellenism in Asia, but they were not concerned with science. We may be sure that they shared the astrological superstitions

of their people, but they were probably incapable of understanding the astronomical work to which this book is devoted. There is no evidence that they ever took any interest in that work.<sup>7b1s</sup>

During the last three centuries B. C., three different kinds of astronomy were cultivated simultaneously within a relatively small area, the Near East, (1) the heliocentric astronomy invented by Aristarchos of Samos (III-1 B. C.)<sup>8</sup> and still defended a century later by Seleucos the Babylonian,<sup>9</sup> (2) the geocentric astronomy which thanks to Hipparchos (II-2 B. C.) became the leading astronomy of the Greeks, (3) the Chaldaean astronomy, concerned exclusively with ephemerides, not with theory.

The first two were essentially of the same kind, and hence the discussion might be restricted to two terms. (1) and (2) represent Greek astronomy, and our own astronomy is derived from both, (3) is Chaldaean and as we shall see presently very different in purpose and methods.

It is strange to think that these two kinds of astronomy grew at about the same time, the Greek one in Alexandria, Rhodos and perhaps Seleucia-Babylonia, the Chaldaean in Babylon and Uruk, and that there were frequent communications among all those places.

The Greeks observed the trajectories of the planets and tried to account for their shapes in geometrical terms. Their purpose has often been expressed by the significant phrase *σώζειν τὰ φαινόμενα*, to account for the phenomena (already observed or to be observed); they assumed that the world was well ordered, a *cosmos*, and they wanted to explain that *cosmos* as faithfully as possible. In order to do that they devised elaborate theories; Plato's contemporary, Eudoxos of Cnidos, invented the theory of homocentric spheres which was improved by Callippos and Aristotle, but shown to be imperfect by Autolykos of Pitane (IV-2 B. C.). A century later, Apollonios of Perga (III-2 B. C.)

<sup>6</sup> The idea that Babylonian astronomers discovered the precession themselves (P. Schnabel, 1927) is certainly wrong; the early history of precession and trepidation is very difficult → O. Neugebauer, "The Alleged Babylonian Discovery of the Precession of the Equinoxes," *JAOS* LXX (1950), 1-8.

<sup>7</sup> The name Chaldaean is sometimes given to the Neo-Babylonian empire founded about 625 B. C. and to the period following. From 538 to 332 Chaldaea was under Persian rule; from 332 to 323 it was ruled by Alexander. The Seleucid dynasty lasted from 312 to c. 64 B. C.; the Arsacid dynasty ruled the Parthian empire from 250 B. C. to 226 A. D.; it ruled part of Babylonia from c. 171 B. C. Most of the tablets investigated by Neugebauer were written during the Seleucid period.

The geographical term Chaldaea denotes the region from Babylon to the Persian Gulf, chiefly on the Euphrates side. The cuneiform tables investigated by Neugebauer come all of them from that very region.

<sup>7b1s</sup> A. Bouché-Leclerc, *Histoire des Séleucides* (2 vols., Paris, Leroux, 1913-14).

<sup>8</sup> The notation (III-1 B. C.) means first half of the third century B. C.; (IV-2) would mean second half of the fourth century after Christ.

<sup>9</sup> We know him only through Strabon (I-2 B. C.) and Plutarchos (I-2). He originated probably in Seleucia on the Tigris; he flourished about the middle of the second century B. C. Seleucia was an important city and Seleucos may have done his work there at least for a time.

originated the theory of epicycles and perhaps also the theory of eccentrics. After a little more than half a century, both theories were applied masterfully by Hipparchos of Nicaia (II-2 B. C.), who was able to give a satisfactory account of the planetary motions. Hipparchos' work was eventually preserved and amplified in the *Almagest* of Ptolemy (II-1). This does not concern us at present because Ptolemy appeared only later, but Hipparchos was a contemporary of Seleucos and of the Chaldaean astronomers. Many of the tablets investigated by Neugebauer were written during Hipparchos' lifetime.

Now those tablets represented a spirit absolutely different from that of Hipparchos. The priests-astronomers of Chaldaea did not try to explain the world in geometrical terms; they accepted it as it was. Their main concern was to determine the calendar as well as possible and thus be able to celebrate religious rites at the proper time; this obliged them to compile lunar ephemerides; for some reasons which are not clear to me they extended the same methods to the five planets; they did all this in an empirical way and their methods were arithmetical rather than geometrical, because they were interested not in trajectories but in characteristic phenomena, such as stations, oppositions, heliacal risings and settings.

Says Neugebauer (p. 281), "One fact stands out when one begins to understand the structure of the planetary theory: the minute role played by direct observation in the computation of the ephemerides. The real foundation of the theory is (a) relations between periods, obtainable from mere counting, and (b) some fixed arithmetical schemes (for corrections depending on the zodiac) whose empirical and theoretical foundations to a large extent escape us but which are considered to be given and not to be interfered with by intermediate observations. It is a strictly MATHEMATICAL theory which we are slowly learning to reconstruct from our fragments."

I take the term mathematical, which Neugebauer underlines, to be opposed to physical: their business was essentially to compute regular tables which would harmonize with the phenomena as well as possible. It is clear, however, that such empirical mathematics is essentially different from the Greek mathematical astronomy as developed by Eudoxos, Callippos, Aristarchos, Apollonios and Hipparchos.

To put it briefly (too briefly) the Greeks were philosophers as well as geometers, the Chaldaeans were empiricists as well as sophisticated calculators. Their ephemerides were partly empirical and largely *a priori*; they suggest a complicated form of divination rather than a new branch of science.

One should not overlook, however, the fact that the priests in charge of the ephemerides were hereditary professionals, and such professionals tend to be more and more absorbed in the technique of their craft and to invent improvements (as is proved by the systems A and B and their modifications). Their work becomes an end in itself; their purpose is no longer religious but purely technical, the preparation of better tables. They began as priests; they ended as astronomers, or perhaps mathematicians.

One cannot help asking oneself: How was it possible for those two different astronomies to develop simultaneously in the same general environment? For Syria and Mesopotamia were not isolated from their western neighbors. The Seleucid rulers and their aristocracy were of Macedonian or Greek origin; there were in their territory a number of Greek settlers many of whom had married native women; there was a continual movement to and fro of soldiers and merchants, clerks and artisans, architects and sculptors, musicians and craftsmen,<sup>10</sup> poets and philosophers. It is true the Chaldaeans spoke their own Semitic dialect, while the Greeks and the Hellenizing people spoke Greek, but that was not an impassable barrier. The true barrier, I am sure, was religious and what would be called today nationalistic. The rulers were surrounded by sycophants as they always are, especially under a despotic regime, but the plain people, guided and excited by their priests, did everything they could to defend their own patrimony, their own culture. Anticolonialism has always flourished sooner or later whenever foreigners have tried to rule other nations. Material defense might be prohibitive or impossible, spiritual defense never was. The Chaldaean priests did not study Greek astronomy; not because they could not (it was relatively easy for them to master the Greek

<sup>10</sup> The abundance of Hellenistic art in Asia was made tangible at an exhibition organized by the Fogg Art Museum of Harvard University in the winter of 1954-55. Mimeographed catalogue by Benjamin Rowland, Jr. (quarto 36 p., Fogg Museum, 1955).

language and they were fully aware of astronomical problems) but because they would not. Their astronomy was the scientific armature of their folklore, the palladium of their folkways.

It is easy to understand their spiritual resistance because the same has been witnessed over and over again in other countries. For example, Ayurveda was popular in British India and so was Indian astrology; in the great cities Ayurvedic doctors plied their trade in the neighborhood of western dispensaries and Indian astrologers, around the corner of well equipped (western) observatories. As a matter of fact, a similar situation can be observed to this day in spite of the immense efforts made by the Republic of India to promote science in every way.<sup>11</sup> The people of India continue their resistance to western science as if that were a relic of colonialism, and something alien to them and dangerous. They have not yet understood that science is international or supranational and that its main function is not to divide nations but to unite them.

It is only in such a manner that the development of Chaldaean astronomy can be understood; it could only develop in an isolated environment, and the isolation could be accomplished only because of their own religion and chauvinism.

Another query arises in my mind. Why did Chaldaean astronomy begin so late? Why was there such an enormous gap between the old Babylonian astronomy and the new one? Was the old science revived as a defense and protest against Western pressure? In that case it might well be called Seleucid astronomy—the astronomy negatively created by Seleucid tyranny.

However you call it, Chaldaean or Seleucid, that astronomy came to an end about the time of Christ. It ended perhaps because of political vicissitudes, and chiefly because there was nothing left to feed it from the outside or the inside. It could not progress as Western astronomy did; it was engaged in a blind alley and died because of its own sterility. There is no record of it in Greek literature nor in any literature except its own.<sup>12</sup>

It disappeared so completely that nobody knew of it until the end of the last century. It was rediscovered by three Jesuit fathers, Joseph Epping (1835-94), Johann Nepomuk Strassmaier (1846-1920), and Franz Xaver Kugler (1862-1929); their work began about 1881 and ended with Kugler's death, or rather it did not end then because some of Kugler's work was published posthumously as late as 1935, twenty years ago. Neugebauer began his own research at about that time. His work is very fittingly dedicated to those three pioneers. Much of that early work remained unnoticed; the first item to be more widely discussed was Father Kugler's *Die babylonische Mondrechnung* (Freiburg, 1900), hardly more than half a century ago.

Until 1881, Chaldaean astronomy was as completely unknown as if it had never been. But there is worse to be said: the development of astronomy would have been exactly the same as it was if the Chaldaeans of the Seleucid period had not written any one of their tablets.

I have remarked about that it would be unpardonable for a teacher of the history of science not to speak of the oriental science which flourished long before the beginning of Hellenic culture. If his course on ancient science had to be completed in, say, thirty-five lectures, he would be obliged to devote at least three or four to pre-Hellenic science.<sup>13</sup> Now what should the same teacher do with regard to Chaldaean astronomy? I do not hesitate to say that the best that he could do would be to leave it out, or to refer to it incidentally in a lecture on Hipparchos.

Please do not misunderstand me and do not misquote me. All I mean is that the teacher who is asked to cover the whole of ancient science in 35 lectures must restrict himself to the essential, to

lioizat (editors): *L'Inde classique, Manuel des études indiennes*, vol. 2, Hanoi, EFEO, 1953 (*Archives internationales d'histoire des sciences*, no. 31, 166-73; Paris, 1955), p. 168.

A little of Indian astronomy percolated into Arabic and Persian astrology and from there into Western writings like those of Pietro d'Abano (XIV-1) and into the frescoes (c. 1470) of the Schifanoja Museum in Ferrara, but none of it ever reached the main stream of western astronomy.

<sup>11</sup> In spite also of Indian academies, universities, scientific societies and of an excellent journal, *Science and Culture* (*Isis* XXVIII [1948], 243).

<sup>12</sup> Except in Sanskrit and Tamil, but that was like passing from one blind alley into another. See Neugebauer's elaborate review of Louis Renou and Jean Fil-

<sup>13</sup> I am guided in saying this by my own experience, for I have often offered such a course to my Harvard students. Ancient science was covered in 33 to 35 lectures; I was obliged to modify repeatedly the program of those lectures, that is, the selection of topics, but pre-Hellenic science was always given its full share.

the main story; he cannot afford to be sidetracked by aberrant developments such as Chaldaean astronomy, ancient Chinese astronomy, or Maya astronomy.<sup>14</sup> I do not say that those developments are not important or not interesting.

On the contrary, they are extremely interesting for two reasons. First, as the astronomical phenomena to be registered or explained are the same all over the earth and as the observers, however different, are essentially alike, their astronomies must include common elements. It is very important to discover those elements, for they may help us better to appreciate the unity of mankind. Second, it is equally important, not simply for historians of science but also for anthropologists to find the characteristics of those astronomies, for they will help us to understand their creators. We have already indicated the differences between Chaldaean and Greek astronomies; those peoples were working at the same time in the same climate; their astronomical differences will help us to define their own.

It is not possible to investigate those differences now and here, but one of them is so curious that I beg leave to describe it; it concerns astrology. It is generally agreed that astrology began in Chaldaea but was developed chiefly in Ptolemaic Egypt, and later in the Greco-Roman world. The first known horoscope is a cuneiform tablet in the Bodleian referring to the date 29 April 410 B.C.; the second is another tablet in the Pierpont Morgan library, referring to 4(?) April 263 B.C.<sup>15</sup> The great mass of early horoscopes, however, is Greek; a corpus of them is being prepared by Neugebauer and Henry Bartlett Van Hoesen.

One would expect the Chaldaeans to be deeply interested in astrology<sup>16</sup> and the Greeks of Egypt

or elsewhere to reject it. It turns out that the truth is the very opposite of our expectation.

There is not a trace of astrology in the tablets edited by Neugebauer; on the other hand, there was quite a little astrological literature in the Ptolemaic world. The famous book ascribed to "Nechepsō-Petosiris" dates probably of the same time as Hipparchos, Seleucos and many cuneiform tablets. What is more significant, however, is this. Hipparchos, the greatest astronomer of this age, was also a defender of astrology. The creator of the *Almagest* was also the creator of the first scientific treatise on astrology, the *Tetrabiblos*; Ptolemy lived in the second century after Christ, but his work was largely derived from that of Hipparchos. The *Almagest* was the astronomical bible until the seventeenth century; the *Tetrabiblos* is the main astrological treatise to this very day.<sup>17</sup>

How can one account for that unexpected aberration? The main purpose of the astrologers was (and is) the drawing of horoscopes, that is, the determination of the relative positions of planets and stars at the very time (day and hour) of a man's birth. The astrologers claimed that a correct interpretation of the horoscope enabled them to predict that man's fate. That was as foolish as any other form of divination but seemed scientific because the drawing of the horoscope was a scientific procedure requiring sound astronomical knowledge and good tables.

It so happened, however, that the Chaldaean ephemerides were not handy for that purpose, while the Greek knowledge and tables lent themselves very well to it. This was purely accidental; the Greeks did not formulate astronomical theories for the sake of astrology, yet they were very well prepared for the acceptance of astrological fancies because of their astral religion, clearly explained in the *Epinomis* by Plato or by one of his disciples. That religion seemed to them more rational and more acceptable than their fantastic mythology. From astral religion to astrology was an easy step down and the political and economic miseries of their age pushed them to take it.

tions had been ascribed to Indians and science exclusively to England. That was sometimes done, but it was very unfair.

<sup>17</sup> Discussion of the *Tetrabiblos* and its tradition in Sarton, *Ancient Science and Modern Civilization* (112 p., Lincoln, University of Nebraska Press, 1954), p. 59-64, 70-71.

<sup>14</sup> To put it otherwise, he must restrict himself to the main stations on the road to modern science and avoid the intriguing bypaths leading nowhere.

<sup>15</sup> Frederick H. Cramer, *Astrology in Roman Law and Politics* (quarto, 292 p., Philadelphia, American Philosophical Society, 1954), p. 5-6.

<sup>16</sup> The more so because the name Chaldaean was early given astrological and occult implications. One of the meanings of the Greek word Chaldaios was astrologer. The Chaldaeans seem to have deserved their bad reputation in other ways.

This is another reason for saying Chaldaean astronomy instead of Seleucid astronomy. It is clear that if we use the adjective Chaldaean only for bad things and Seleucid for good ones, the poor Chaldaeans are hopelessly traduced. It is as if in British India, supersti-

Both our astronomy and our astrology stem from Greek examples, especially from Hipparchos and Ptolemy; they would be the same if the Seleucid tablets had never been written, or had never been discovered and deciphered.

We must be very grateful, however, to the old scribes and to the new palaeographers like Neugebauer. Thanks to their devotion, new aspects of science have been revealed to us. We can do very well without Chaldaean astronomy, even as we can do without tables of trigonometric functions or

without quaternions, but those great achievements have not been made in vain.

The book is beautifully got up and its price is very moderate. We owe much gratitude to the author and not a little to the master printer and to the Institute for Advanced Study in Princeton, New Jersey, whose enlightened generosity made this publication possible. We much hope that Dr. Neugebauer will eventually give us the larger History of Ancient Astronomy to which he refers in his preface.

## THE LAURENTIAN BIBLE OF MARCO POLO

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IT IS IN TRIBUTE to Messer Marco Polo, whose seven-hundredth anniversary the City of Venice and the world celebrated last year,\* that I have undertaken this short paper for the American Oriental Society having now its annual meeting in Toronto conjointly with the Society of Biblical Literature and Exegesis.<sup>1</sup>

The organizers of the exhibition, "L'Asia nella Cartografia degli Occidentali," reviewed the efforts to bring out the genuine documents from those in Marco Polo's possession: manuscripts, maps, books, transmitted from him. Nothing new was found.<sup>2</sup> His great geographic legacy was presented by the most interesting exhibition arranged in the Biblioteca di San Marco in Venice by Signora Dr. Tullia Leporace, its scholarly director.

In the catalogue by the celebrated Antonio Maria Biscioni (1674-1756), Prefect of the Biblioteca Medicea Laurenziana,<sup>3</sup> in vol. I (1752), p.

121, there is an entry connected with Marco Polo which we may render into English as follows:

The Vulgate edition of the Latin Bible which was found in this library at the end of the last century, and to it the following written testimony was attached:

"The Holy Bible found in China in the possession of a native living in the City of *Xam Xo*, Nanking Province. He maintained that the Bible was a family possession descending to him from the times of the royal dynasty of *Yuén*, the house of the Western Tartars who occupied China over four hundred years ago. With the Tartars came Marcus the Venetian, who probably brought the Bible from Europe himself; if not he, then some other European. Confidence must rest upon native information. So I judge. [signed] Philippe Couplet, S.J., Procurator [of the Society] in China who came to Rome."

Latin parchment codex, manuscript of about the thirteenth century, incomplete and very lacerated, in octavo.<sup>4</sup>

*peratorii magni Etruriae ducis, etc. etc. etc. digestus atque editus.* Tomus primus codices orientales complexens. Florentiae. Anno M.DCC LII, Ex Imperiali Typographio, superiorum adprobatione. 4 vols., 1752-1770.

<sup>4</sup> Cf. Biscioni, op. cit., I, 121: *Biblia Latina vulgatae editionis, quae e Sina in hac Bibliotheca dicta fuere, prope praeteriti saeculi finem: cuique inscriptum testimonium adnexum fuit.* "S. Biblia inventa in Sina apud Ethnicum quemdam commorantem in civitate, *Xam Xo* dicta, Provinciae Nankini. Affirmabat hic ea esse a maioribus suis relicta iam inde a temporibus familiae regiae, *yuén* dicta, quae fuit Tartarorum Occidentalium qui a 400 & amplius annis Sinam occuparunt, cum quibus venit Marcus Venetus, qui probabiliter ex Europa eam secum attulerit, aut quavis alius Europaeus. Fides sit penes authorem Ethnicum. Ita censeo Philippus Couplet S. I. e Sina in Urbem Procurator." Cod. Lat.

\* I am grateful to the American Philosophical Society for a grant-in-aid, enabling me to undertake in 1954 research in European archives and in Biblioteca Medicea Laurenziana.

<sup>1</sup> This paper was read on April 19, 1955, before the Society meeting at Toronto.

<sup>2</sup> Cf. also Tullia Gasparrini Leporace, *Mostra L'Asia nella Cartografia degli Occidentali*. (Venezia, Biblioteca Nazionale Marciana, exhib., June 19-October 10, 1954), p. 3.

<sup>3</sup> Biscionius, Antonio Maria, *Bibliothecae Medico-Laurentianae catalogus ab Antonio Maria Biscionio S.T.D. et basilicae S. Laurentii canonico ac eiusdem bibliothecae regio praefecto sub auspiciis Francisci Romanorum im-*