Reconstructing ancient chronology can be a tricky business. The ancient historical documents themselves occasionally provide conflicting testimony, including errors of transmission and rare instances of intentional forgery. Ancient cultures employed a variety of calendars to record their day-to-day activities making it difficult to correlate the calendars of one culture with another, to say nothing of correlating ancient calendars with modern calendrical systems. Correlating the information derived from radiocarbon dating, bristlecone pine dating, and the ice cores has proved to be something less than an exact science, thereby limiting their use for constructing an absolute chronology. How, then, can we arrive at a secure means for dating a particular king or civilization?

For the purposes of illustration, let's consider the reign of Nebuchadnezzar, one of the most famous kings of all antiquity, singled out in the Old Testament for his cruelty and for leading the Jews away into captivity (II Kings 25:1-21). Nebuchadnezzar's relative place in history is securely attested by the numerous documents that have come down to us from this period. The so-called canon of Ptolemy, for example, provides a complete list of kings from the time of Nabonassar (746 BCE) to Antonius Pius (138-161 AD). There Nebuchadnezzar appears as the 16th king of Babylon after Nabonassar.

As it turns out, the accuracy of Ptolemy's canon can be confirmed at every step and in great detail. As Carl Jonsson has shown in a masterful summary of the available evidence, a variety of king lists, chronicles, economic transactions, and astronomical documents from ancient Babylon and elsewhere all serve to confirm the reign-lengths of the kings from Nebuchadnezzar's time until the time of Alexander the Great (see C. O. Jonsson, "The Foundations of the Assyro-Babylonian Chronology," Chronology and Catastrophism Review 9, pp. 14-23). Thus, the Uruk king list, various business documents, and Berossus all agree with Ptolemy that Nebuchadnezzar reigned for a period of 43 years (See Jonsson's argument). Most interesting, perhaps, is a stele written by Nabonidus' mother, the latter being a contemporary of Nebuchadnezzar's, which likewise credits the Neo-Babylonian king with a reign of 43 years. In short, working strictly from the abundant historical documents from the Neo-Babylonian and succeeding periods, it is possible to count backwards from the time of Alexander the Great (330 BCE) to the time of Nebuchadnezzar. Employing such methods,

historians have dated this king to 604-561 BCE (see also R. Parker and W. Dubberstein, Babylonian Chronology, 1942, where various documents are listed which serve to date the beginning and ending of Nebuchadnezzar's reign).

But how can we be certain that Nebuchadnezzar truly lived 2600 years before present? Would not errors and discrepancies in the chronology of subsequent periods, such as the Dark Ages of Europe during the Middle Ages, conspire to displace the Babylonian king in time?

It is here that astronomical retrocalculations, properly employed, can be a powerful tool in reconstructing the fundamental benchmarks of ancient chronology. In order to obtain reliable retrocalculations, it is necessary to have accurate celestial observations from a given place and time together with the means to compute the positions of the respective celestial bodies at specific times and longitudes. We have an abundance of accurate astronomical observations from the time of Tycho Brahe onwards, for example, so it is a relatively easy matter to feed the corresponding celestial details into a high-powered computer and retrocalculate a map of the skies from 1576 to 1601 AD, the period of Tycho's observations. Upon performing this analysis, modern astronomers have confirmed that the computed map agrees exactly with the Dane's observations. It follows that the fundamental order of the solar system has not changed since the time of Tycho Brahe and that his place in history can be absolutely dated to 1576 AD.

In principle it should be possible to apply the same scientific methodology to more ancient times. As it turns out, there are hundreds of astronomical diaries from ancient Babylon which have been recovered (over 1200, in fact), some of which include detailed astronomical observations that provide an accurate map of how the skies looked during that period. Typically these diaries record the locations of the sun, moon, and respective planets against the celestial backdrop (the so-called normal stars along the ecliptic) over a period of six months or so. The oldest diaries still extant date to 651 BCE (note that this date is astronomical dating convention, with 652 BCE being the historical dating convention), although the practice of organizing diaries is thought have originated during the time of Nabonassar (746 to 732 BCE). [The latter opinion, in part, is based on Ptolemy's statement that from Nabonassar "and on the old observations have been

preserved, in the large, until the present day." (Almagest 3:7)]

The importance of these diaries for the history of astronomy can hardly be overestimated. Not only did they serve as the observational basis for all subsequent Babylonian astronomy, they likely formed the source of the eclipse and planetary compilations assembled by Hipparchus (see the discussion in G. Toomer, "Hipparchus and Babylonian Astronomy," in E. Leichty ed., A Scientific Humanist: Studies in Memory of Abraham Sachs, 1988, p. 359; F. Rochberg-Halton, "Babylonian Astronomical Diaries," Journal of the American Oriental Society 111.2, 1991, pp. 323-332) A leading historian of astronomy offered the following observation:

"The Diaries occupy a unique position among documents of relevance to the study of ancient history. The ever presence of the swiftly moving Moon enables us to date the texts, if we can date them at all, to the very day, and in sheer bulk, continuity, and detail and kind of information they are unmatched." (A. Aaboe, "Observation and Theory in Babylonian Astronomy," Centaurus 24, 1980, p. 24.)

For our purposes here, let's consider a diary from the reign of Nebuchadnezzar. The following are some of the relevant observations from the document known as VT 4956:

"Year 37 of Nebukadnezar, king of Babylon. Month I, (the first of which was identical with) the 30th (of the preceding month), the moon became visible behind the Bull of Heaven;…Saturn was in front of the Swallow…[The 11th] or 12th, Jupiter's acronychal rising…Month II…Saturn was in front of the Swallow; Mercury, which had set, was not yet visible…The 3rd, Mars entered Praesepe. The 5th, it went out (of it)…The 18th, Venus was balanced 1 cubit four fingers above α Leonis…Month III, (the 1st of which was identical with) the 30th (of the preceding month), the moon became visible behind Cancer…At that time, Mars and Mercury were 4 cubits in front of α [Leonis…] Mercury passed below Mars to the East; Jupiter was above α Scorpii; Venus was in the west opposite ϑ Leonis…Month XI, (the 1st of which was identical with) the 30th (of the preceding month), the moon became visible in the Swallow; …At that time, Jupiter was 1 cubit behind the elbow of Sagittarius…The 4th, Venus was balanced 1/2 cubit below Capricorn…Month XII, (the 1st of which was identical with) the 30th (of the preceding month), the moon became visible behind Aries while the sun stood

there…Around the 20th, Venus and Mercury entered the 'band' of the Swallow." (H. Hunger, pp. 47-51)

It can be seen at once that these astronomical observations are sufficiently detailed that modern astronomers can reconstruct the positions of the respective planets against the background stars with some precision. Most important, however, is the fact that this particular arrangement of the planets will not repeat itself for many millennia, if ever (this is because the celestial backdrop is always changing due to the rotation of the earth and precession of the equinoxes). It follows that the particular order of the heavens recorded by the astronomer of Nebuchadnezzar's time can serve as a precise benchmark for the king's place in history. All the modern astronomer has to do is program his computer to find the year in which the various planets are aligned in the specific order prescribed by Nebuchadnezzar's diary. As I understand it, this retrocalculation has already been performed by various astronomers (I am currently in the process of attempting to repeat this test). According to Hermann Hunger and Abraham Sachs, the observations from this tablet describe the celestial situation pertaining from –567 March 23/24 to April 11/12 –566. (H. Hunger ed., Astronomical Diaries and Related Texts from Babylonia," Vol. I, 1988, p. 52). It hardly needs to be pointed out that this is the very date historians had long assigned to Nebuchadnezzar's 37th year upon the basis of his place in Ptolemy's canon and other ancient documents.

The astronomical diaries published by Hunger and others cover the period from 652 BCE to 150 BCE, so it is possible to date other kings by following the same strategy. Alexander the Great, Artaxerxes I and various other kings are mentioned in these diaries. The date for the diary (BM. 36761) mentioning Alexander the Great's triumphant entry into Babylon retrocalculates to 330 BC, the very time period historians had previously assigned this great conqueror.

To summarize our conclusions to this point: Astronomical retrocalculations provide a ready means of securing an absolute date for a particular king or civilization should sufficiently accurate astronomical information be available. Astronomical retrocalculations can thus serve to either confirm or reject the relative dates for particular kings derived from ancient literature and stratigraphy. If the celestial order described by

Nebuchadnezzar's royal astronomers is unique to that period—and it is—the odds are literally astronomical that astronomers' computer-aided retrocalculations would produce the very date (-567 BCE) otherwise assigned this ruler by historians working solely with the historical records. Even more improbable are the odds that the respective reigns of Nebuchadnezzar, Artaxerxes I, Alexander the Great and various other kings mentioned in these documents would likewise conform with the very order and dates deduced by historians. Impossible in fact.

It is important here to underscore the formidable problem such retrocalculations pose for theorists like Heinsohn, Velikovsky, and Fomenko, who would shuffle the ancient dynasties like a pack of cards. Heinsohn, for example, would seek to downdate Nebuchadnezzar to the Persian period; e.g., sometime after Darius the Great! Indeed, Heinsohn would identify Nebuchadnezzar with Artaxerxes I. Yet, as we have seen, the latter king is also mentioned in the Babylonian astronomical diaries and the sky described in those diaries—and the retrocalculated dates, needless to say—cannot by any means be brought into accord with the sky described by Nebuchadnezzar's diaries. It follows, as sure as night follows day, that Heinsohn's identification of Nebuchadnezzar and Artaxerxes I is impossible.

Nebuchadnezzar is also mentioned in the so-called Saros texts, a series of five tablets listing the various lunar eclipses from the eighth century to 317 BC.

"All of the surviving observations (and predictions) of lunar eclipses from earliest times (731 BC) to 609 BC—as well as many later observations down to 317 BC—are recorded on a series of five British museum tablets. Their reference numbers are: BM 32238 (=LBAT 1414), BM 45640=35115=35789(=LBAT 1415=1416=1417: three joining pieces) and BM 32234 (=LBAT 1419). This major compilation, which lists eclipses at 18-year intervals, originally covered 24 saros cycles or 432 years and extended from some time between 749 and 740 to between 317 and 308 BC. The extant remnant listed as BM 32238 cites eclipses from 731 to 659 BC (obverse) and from 389 to 317 (reverse). Tablets BM 45640+35115+35789 contain data from 703 to 632 BC (obverse) and from 415 to 360 BC (reverse), while BM 32234 extends from 609 to 537 BC (obverse) and from 519 to 447 BC (reverse). Many names of rulers are preserved on these tablets: e.g. Nabu mukin-zeri (who reigned from 731 to 726 BC), Bel-ibni (702-699 BC), Samas-sum-ukin (667-647 BC),

Kandalanu (647-625 BC), Nebuchadrezzar II (604-562 BC), Xerxes I (485-465 BC) and Philip (323-316 BC). From the well-defined chronological sequence on this series of texts, virtually all eclipse dates can be confidently restored." (149)

"BM 38462 (=LBAT 1420) reports lunar eclipses for almost every year from the beginning of the reign of Nebuchadrezzar II (604/3 BC) to his 29th year (576/6 BC). The damaged (but still recognisable) name of Nebuchadrezzar is given on the first line of the tablet." (149)

With reference to BM 32234=LBAT 1419, an eclipse of April 1/2, 573 BC:

"[Nebuchadrezzar II, year 31, month XII…]…Saturn in Capricorn…Mars 2 cubits in front of a Sco. (Began) at 1,30 (=90) deg after sunset."

The immediately following entry in the same column of this text specifically mentions Nebuchadrezzar in recording an eclipse which passed by in month VI of his 32nd year (i.e., BC BC 573 Sep 26). On the night of Apr 1/2 in BC 573, Mars was about 5 deg (or roughly 2 cubits) distant from a Sco but it was located to the *north* of this star rather than west of it (as implied in the text)." (166)