Saguaro Astronomy Club

Metro Phoenix, Arizona

SACNEWS

July 1993 — Issue #198

Marcus Manilius and Ancient Astronomy

by Ian Bacon with the assistance of Dr. Jane Bellemore

I "met" Ian April 1992 after seeing a E-mail message from him inquiring whether anyone had knew of material about Manilius. His topic seemed interesting, so I sent him a message asking if he would write an article on the subject for SACNEWS. He agreed, but said to would be several months before the article would be ready. More than a year later, a year complete with illnesses and class work, the article is finally here.

Marcus Manilius, a Roman poet of the early imperial period, is one of the least known astronomers of the ancient world, and his work, the "Astronomica", is largely derivative conveying little new information on ancient astronomy. Not withstanding this he does present areas of interest for scholarship. In this paper will look at his life and work in some detail, but in order to do that, we shall first place Manilius, and ancient astronomy into their cultural backgrounds.

All ancient civilisations, the Chinese, Babylonians, the Greeks and the Romans had some interest in the sky. This interest ranged from the mundane tasks of maintaining the calendar and assisting navigation to that of astrological predictions. However, it was the Greeks who first applied deductive logic to the examination of the material universe and distinguished astronomy from astrology. Beginning in the fifth century BC and continuing to the first century BC the Greeks founded and made large scale progress in the science of Astronomy.

This progress included knowledge of: the sphericity of the Earth; the existence of the Zodiac / ecliptic; the movement of the planets; explanation of and limited prediction of eclipses; not inaccurate measurements of the relative sizes of the Earth, Sun and Moon; the creation of a stellar positional system based on the ecliptic (an ecliptic coordinate system with celestial Latitude and Longitude) with a one – six stellar magnitude system (still with us today) and of course, a calendar.

The Greeks established the basics of astronomy; however, they and subsequently the Romans were hampered by their conceptualisation of the Universe, that of a "perfect" heaven with perfect circles. This, with an Earth centred, geocentric universe resulted in increasingly complex models to explain planetary behaviour. Each planet (including the Sun) was made to move around the Earth in a perfect circle. To explain discrepancies between theory and observation, circles were added to circles in an ascending order of complexity. Increasingly complex constructs of epicycles, eccentrics and equants formed which persisted unchallenged through the European middle ages, the Arab world and into the sixteenth century European

Quick Calendar

SAC Meeting
7:30, Friday, July 2

Deep Sky Meeting
Ophiuchus
Thursday, July 8

SAC Star Party
Buckeye Hills Recreation Area
Saturday, July 17

SAC Star Party
Buckeye Hills Recreation Area
Saturday, August 14

SAC Meeting
7:30, Friday, August 27

SAC Officers

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renaissance.

Greek and Roman science was not only restricted conceptually but was also restricted by a low level of technology. There were few instruments, and their accuracy was low. Ancient mathematical systems were limiting. There were two mathematical systems used by Greek astronomers, one of which did not have a place value, nor did it recognise the importance of zero, nor could it manipulate fractions well. The other, inherited from Mesopotamia and the Babylonians, was a place value system with a zero but a base 60 mathematical system (the basis for our 360 degrees, with 60 minutes and seconds of arc and of time). Added to this, there were no aids to calculation, even the humble logarithm was not developed till the 16th century. These factors placed a limit on scientific progress.

This is typified by one of the Greek's greatest astronomers, Hipparchus. Living in the 2nd century BC he was essentially the last of the original thinkers of Greek science. Only one of his minor, earlier works directly survives, but his research is much discussed and used by his successors. He is known to have: constructed the first model of luna and solar motion based on observational evidence; discovered the precession of the equinoxes: possibly the first to use trigonometry in his calculations and determine the length of the tropical year to 365.25 days with an error of plus/minus five minutes. He had a passion for observational accuracy and the use of mathematics to solve problems. This is demonstrated by his refusal to construct a solar system theory as he believed there was insufficient data and mathematical tools to do so accurately.

...the Roman calendar was an active example of political neglect until Julius Caesar...corrected it.

However, within their limits the Greeks made greater scientific progress than any of their cultural predecessors. The Greeks invented the concept of deductive and inductive logic, and rational thought, one half of the scientific method paradigm of theory and empirical research. From this flowed progress in all fields of human endeavour; science, medicine, mathematics, architecture and more. As with Astronomy, much of this was not equaled until the sixteenth or seventeenth century.

By the time of the first century BC the Roman world of Italy and western Europe had fallen under the spell of Greek and Near Eastern cultural influence: Upper class Romans spoke and read Greek; their children studied in Athens; Greek words entered the Latin language; Greek art and philosophy was a necessity in any house of distinction. One of these new Eastern influences entering Rome were the joint beliefs and knowledge of astrology and astronomy.

Astronomy was by and large not important to the Romans beyond its ulitarian functions. Even then the Roman calendar was an active example of political neglect until Julius Caesar, returning from Egypt and Cleopatra, corrected it. In the field of Astronomical observation and theory the Romans did little, relying on earlier Greek theories and observations as the basis for any speculation.

Astrology played an ambivalent role in the Roman world. It was practised by many prominent Romans, including the Emperor Tiberius (AD 14–37). The second century AD Roman historian Suetonius writing in "The Twelve Ceasars" tells us that the future Roman Emperor Augustus, as a young man, visited an astrologer to uncover his fate — the stars foretold his greatness. Suetonius continues with a similar anecdote in which another astrologer, the Roman Publius Nigidius Figulus, also made the same prediction concerning Augustus. Despite some public acceptance astrology was harshly dealt with by the Roman authorities when its usage caused public disorder or threatened political security. At various intervals, usually related to political upheaval, astrologers were expelled from Rome.

There are nine recorded expulsions of astrologers between 139 BC and AD 93. The supposed cause of these expulsions was public disorder caused by their astrological predictions. After the transformation of Rome from a Republic to an Empire, ruled by an Emperor, the rationale behind official action against astrology changed somewhat. Political concern centred around the longevity of the Emperor and his potential successor. In AD 11 (in his 74th year, three years before his death) the emperor Augustus forbade the prediction of a person's death and published his own horoscope, both, presumably, to minimise speculation as to the time of his own death.

The aim of these expulsions, which also included that of philosophers, mystics and diviners, was not to discredit or destroy astrology but to curtail the politically significant activities of its practitioners. Part of the official concern was that astrology, and other means of divination, would be used to predict the Emperor's death. This is not to suggest that the Roman culture gave astrology full faith and credence but, a prediction used at the appropriate moment, could destabilise an Emperor's position, or encourage a revolt. The mere claim that a prominent person had asked these question of an astrologer became grounds for treason.

It is important to put ancient astrology into its cultural context. The ancients were not technologically advanced. While we can rightfully heap scorn on those who believe and practice astrology in the modern world we should remember that those in the ancient world lived surrounded by the forces of nature that they neither understood or control. We should not criticise the ancient astronomers for their belief and practice of astrology but remember that the great names of modern astronomy, Copernicus, Brahe etc. also practised astrology to pay their bills.

It is with this cultural background that we turn to the main topic of this paper, Marcus Manilius.

All that we know of Manilius comes to us from his work, a poem explaining the "science" of astrology to his audience. The poem is, known as the "The Astronomica". It is divided into five "books", essentially chapters, totalling approximately 25,000 words. Books 2–5 discuss astrology in great detail. However, Book 1 forms an introduction to the later astrological text by providing an astronomically oriented summary of the heavens. This book tells us something of Manilius' perception and knowledge of the Universe. Unfortunately, while he does describe much in detail he gives no specific, datable, events.

What we have gleaned from his work is that he lived and wrote in the reigns of Augustus, the first Roman Emperor, and in that of Tiberius, Augustus's successor. Their combined reigns covered the period circa 30 BC to AD 37. Manilius evidently had a good education and the leisure and income to spend years pursuing his goal. His motivation for writing the "Astronomica" is as hard to fathom. He may have felt he had a message to give to the Roman world.

It is not known if Manilius wrote other works since certainly none has survived, nor is it known how successful his work was to his contemporaries. Internal evidence suggests that Manilius' wrote between circa AD 10 to AD 20. One translator of Manilius, G.P. Goold, tells that there are indications that contemporary authors may have used Manilius as a minor source. There is no major reference to his work until the fourth century. He was not considered one of the great authors of antiquity. After the 5th century Europe entered the early Middle Ages where little or no science of any description was practised. During this period the Astronomica languished in monasteries. In the 10th century the Astronomica was mentioned twice, once by Pope Sylvester II and once in a catalogue of books. There are now about twenty copies in existence preserving three different versions of the original text, all with minor gaps. These texts date from the 11th and 15th centuries when they were themselves recopied from earlier works. It has been the work of classicists in this and the last century to analyse and produce a reliable version of Manilius' original work.

The time in which Manilius wrote was the culmination of a tumultuous period of Roman history, the transformation of the Republic, a landed oligarchy (with democratic elements), into the autocratic Roman Empire, ruled by an Emperor. This transformation was implemented at

Comet Comments

by Don Machholz

(916) 346-8963

June 9, 1993

Several faint comets have been recovered, with two new ones discovered. Meanwhile, Periodic Comet Shoemaker-Levy 9 continues to draw attention.

Periodic Comet Shoemaker-Levy 9 (1993e): This strange object, the "string of pearls" comet, remains in the vicinity of Jupiter. The latest orbit calculation indicates that it was close to Jupiter (0.0008 AU from the center) in July 1992. This caused the comet to split into many pieces. A year from now, in late July 1994, it is expected to get even closer — 0.0003 AU distant. Since Jupiter is 0.0005 AU in radius, the present theory is that at least some of the many nuclei will collide with Jupiter itself. Predicted positions for the comet are printed below. Although the comet is faint, you may wish to attempt photographic or CCD imaging of it.

Periodic Comet Shoemaker-Levy (1993h): Carolyn and Eugene Shoemaker and David Levy discovered this comet on plates exposed through the 18-inch Schmidt at Mt. Palomar on May 23. The comet was then at magnitude 17 and is expected to remain faint.

Periodic Comet Holmes (1993i): T. Seki of Japan recovered this comet using photographic equipment on May 24. Already past perihelion, it will remain faint.

Periodic Comet Neujmin 3 (1993j): Jim Scotti of the Lunar and Planetary Laboratory at Kitt Peak recovered this comet on May 25 at magnitude 21. It will not get much brighter.

Periodic Comet Shajn-Schaldach (1993k): Jim Scotti also recovered this faint comet. It has an orbital period of 7.5 years but will remain beyond amateur's scopes.

Periodic Comet Helin-Lawrence (1993L): E. Helin, K. Lawrence and M. Nassir exposed plates on the 18-inch Palomar Schmidt to discover this comet on May 17. It was at magnitude 17, but the orbit has not yet been computed.

Periodic Comet Shoemaker-Levy 9 (1993e)

Date	RA-2000	Dec	Elong	Sky	Mag
06–22	12h00.3m	$-03^\circ02'$	91°	E	13.6
06–27	12h02.0m	$-03^\circ09'$	86°	E	13.6
07–02	12h03.9m	$-03^\circ16'$	82°	E	13.7
07–07	12h06.1m	$-03^\circ26'$	78°	E	13.7
07–12	12h08.4m	$-03^\circ37'$	74°	E	13.7
07–17	12h10.9m	$-03^\circ49'$	70°	E	13.7
07–22	12h13.7m	$-04^\circ02'$	65°	E	13.8
07–27	12h16.5m	$-04^\circ17'$	61°	E	13.8
08–01	12h19.6m	$-04^\circ32'$	57°	E	13.8
08–06	12h22.8m	$-04^\circ47'$	53°	E	13.8

great cost in human life and suffering. Manilius and his contemporaries looked back upon this period before the Empire as a period of social decay and anarchy. They feared its return and considered Augustus and the imperial system he created their protection against its return. Manilius supports the Imperial regime created by Augustus. His work is dedicated to Augustus and where possible takes the opportunity to praise the accomplishments of Augustus.

In addition to being an astrologer Manilius was an adherent of Stoic philosophy. Stoicism had been founded in Athens four centuries earlier and had come to Rome during the second century BC finding acceptance amongst a portion of the Roman population. Its credo of duty to the State and personal morality found appeal amongst a population undergoing cultural and political transformation, as the full social ramifications of Rome's conquest of the Mediterranean in the 2nd century BC affected Roman society. Later, during the Imperial period, Stoics were, by and large, passively supported by the state. One of Stoicism's tenets was acquiescence to authority — a worthy principle in an autocratic state. Other Stoic tenets perhaps held less appeal since Greek Stoicism contained a theoretical belief in sexual equality and the abolishment of slavery. Even the Greeks observed these more in the breach than the observance. The Romans adapted Stoicism to their own more practical culture.

Stoic philosophy provided a guide to all aspects of life and thought and within this design there was an Astronomical belief system. Stoics believed in a "living", cyclic universe that periodically destroyed and then reconstituted itself. The elements, fire, air, water and earth formed the basis of this universe. God, as a rather abstract concept, permeated and was part of the entire universe. The Earth was the centre of the universe with the Moon, Mercury, Venus, Sun, Mars, Jupiter, Saturn and the stars (in that order, closest to furthest) revolving in perfect, circular paths around the Earth. Due to the interrelationship between all components of the Stoic Universe a change in one part was thought to cause a change in another. This axiom gave Astrology a rational basis — a change in the heavens foretold a change on the Earth. Manilius wrote his astrological work from a Stoic perspective.

In creating his work Manilius it seems was in part refuting a rival philosophy to Stoicism, that of Epicureanism. Founded by the Greek philosopher Epicurus three centuries earlier Epicureanism was a philosophy oriented less towards disciplined service to the State than towards a life of self fulfillment and enjoyment. In a letter Epicurus states that "We say that pleasure is the beginning and end of living happily." This found less acceptance in the Imperial period where unstinting (and unquestioning) service to the State was viewed with favour. Writing approximately 50 years earlier than Manilius the Roman poet Lucretius, himself an active practitioner of the Epicurean life style, expounded this philosophy to the Roman audience in his work, "De Rerum Natura" (Concerning the Nature of Things).

Two of the prime axioms of Epicureanism that reach us in the surviving work of Lucretius, are that the Universe does not have a divine origin and that reason alone must be used to examine the Universe. These, and an "atomic" theory (that all matter is composed of small, eternal, indivisible particles), endeared this materialistic philosophy to scientists of the seventeenth century AD, and onwards, while creating continual polemic with the Stoics of antiquity.

There are a number of passages by Manilius which seem to refute precise passages by Lucretius. There are

SAC and SAC Meetings

Saguaro Astronomy Club (SAC) was formed in 1977 to promote fellowship and the exchange of scientific information among its members — amateur astronomers. SAC meets monthly for both general meetings and star parties, and regularly conducts and supports public programs on astronomy.

SAC meetings are usually held on the Friday nearest the full moon. This means that over the course of the year, meetings are not held on same week of the month. The same is true of the club's star parties. Star parties at Buckeye Hills are mostly held on the Saturday of the third quarter moon.

1993 SAC Meetings
Jan. 8
Feb. 5
Mar. 5
Apr. 2
May 7
Jun. 4
Jul. 2
Aug. 27
Sep. 24
Oct. 29
Nov. 19
Dec. 18 Party

1993 SAC Star Parties

Date	Sunset	Moonrise
Jan. 16	5:46pm	3:11am
Feb. 13	6:12pm	2:05am
Mar. 20	6:41pm	5:24am
Apr. 17	7:01pm	3:55am
May 15	7:22pm	2:25am
Jun. 12	7:38pm	12:55am
Jul. 17	7:38pm	4:44am
Aug. 14	7:15pm	3:39am
Sep. 11	6:40pm	2:15am
Oct. 9	6:03pm	1:04am
Nov. 6	5:33pm	11:57pm
Dec. 11	5:22pm	6:35am

also similarities in the two works as to the layout of some arguments. It is a reasonable assumption that Manilius identified arguments in Lucretius and set out to discredit them in his own work. The slow pace of philosophical debate in the ancient world makes a 50 year exchange of academic criticism possible. By praising Augustus and criticising Epicureanism Manilius is playing his part in the maintenance of the imperial order, and countering a rival philosophy.

There are parallels between Manilius and another earlier author, Aratus of Soli, a Greek Stoic poet who wrote an astronomical poem, the "Phaenomena," circa 275 BC. His work gives astrology a minor role. What makes Aratus's work of particular interest is that it is allegedly based on the work of one of the Greeks' greatest astronomers, Eudoxus of Cnidos (c390–c340 BC). Regrettably none of Eudoxus's work survives directly. We rely on the reporting of others for information on his accomplishments.

Aratus's work was popular in ancient Rome. There are four extant translations of it from Greek into Latin. As a noted Stoic author it is not surprising that Manilius used Aratus as a template for his own work. Proof that he assiduously followed the format of Aratus is his continuation of an erroneous point made by his Greek exemplar. While describing the celestial poles Manilius refers to them as "fixed and unchanging." This is also the description given by Aratus. In circa 140 BC the Greek astronomer Hipparchus discovered the precession of the equinoxes, invalidating Aratus's earlier statement, but Manilius has not incorporated this discovery into his own work.

What this lapse tells us is uncertain. It must be remembered that Manilius was writing an astrological work of art, not an astronomical treatise. It is not impossible that he simply disregarded the empirical materialist Hipparchus as irrelevant to the true aim of his work and followed the popular Stoic Aratus. In a similar fashion modern astrologers still use a geocentric universe essentially unchanged from that of Manilius as the basis for their predictions.

It is reasonable in any case to conclude that book one of Manilius' work, which is a astronomical introduction to the full work, is based on the work of Aratus.

Manilius' work is aimed at a sophisticated audience. It is not a practical "hands on" guide to casting a horoscope but the equivalent of an academic discussion of astrology. In this it seems to follow the imperial aversion to predictive astrology.

Manilius begins book one by telling us about the background of astrology — how men, in "primitive" times, did not know the "why" of the universe but after careful research knowledge increased until the peak of learning was mastered — that of astrology. Manilius firmly identifies with astrology and regards astrology as the culmination of human scientific progress.

He next describes various cosmological theories, asking: does the universe has a beginning or end; was it born from chaos; is it composed of atoms; composed of fire or of the four elements (earth, water, air & fire)? His greatest effort is reserved for a detailed explanation of his own Stoic philosophy. There is a curious parallel between these theories and modern cosmological thought. However, rest assured, that any perceived similarity between Manilius' suggestion that the universe has no beginning nor end and the Steady State Theory is purely coincidental.

In book one Manilius is at pains to prove to the reader that the Earth is a sphere. He mentions the Earth's shadow during Luna eclipses. He particularly notes the star Canopus, which was not visible from Rome but visible further south from Rhodes. This continued emphasis on the spherical Earth suggests a hidden motive. Lucretius (discussed above) wrote that a spherical Earth where people and animals walk about "upside down" was ridiculous. In this case Manilius refutes Lucretius and Epicureanism. It is also reasonable to assume that he was attempting to prove the fact of a spherical Earth to a sceptical lay audience.

The time in which Manilius wrote was [during] the transformation of the Republic into the autocratic Roman Empire

Next, the constellations are described. The constellations we possess today are those known by the Greeks and Romans. However the ancient constellations did not cover the entire sky. Some stars were outside any constellation. Such stars were "associated" with a neighbouring constellation. Manilius begins his description of the constellations with the Zodiac, continues with the northern constellations and then concludes with the southern. Manilius lists 46 constellations, two of which are errors on his part. The furthest south of these is Centaurus. At the end of his list of constellations he states that "they are the roof of the Universe." The stars, in his opinion, formed the sphere most distant from the Earth. They were at the "top" of the sky.

In Manilius' time there existed a sky slightly different from our own. Two thousand years of precession lies between us; — for Manilius the first point of Aries was in Aries; the north celestial pole lay near Beta Ursa Minor, twelve degrees from its present position; Polaris was no more than another second magnitude star; from southern Egypt the Southern Cross was visible just above the horizon. Manilius relates how seafarers, particularly Phoenicians (the ancient inhabitants of what is now Lebanon), used both Ursa Minor and Major for navigation, but preferred Ursa Minor as it was the more accurate, though fainter, guide.

Manilius does refer to the theoretical existence of southern constellations. This is partly given as additional

proof of the sphericity of the Earth. He tells us that the southern sky will be filled with "ordinary" constellations and not strange or unusual figures. It is Manilius' belief that the southern sky has constellations similar to the northern. He suggests this as he believes the two halves of heavens should "balance." It may be that he is striving to suggest to his readers that the southern sky is essentially the same as the northern. At this point in history no living Mediterranean dweller had reported seeing the far southern sky. As always, the great unknown generated fantasies of mythical existences which Manilius tried to refute.

Manilius' description of the constellations varies. Some are merely listed ("...these the Crab follows, then the Lion, then the Virgin...") while others, usually the brighter and larger are described in more detail, ("...Orion may be seen stretching his arms over a vast expanse of sky and rising to the stars with no less huge a stride. A single light marks Orion's head, which is impeded in high heaven with his countenance remote. It is Orion who leads the constellations as they speed over the full circuit of heaven..."). Many constellations have a description of their mythological background.

It is clear from this form of description that Manilius was not attempting to write a quantitative catalogue of stellar positions. If we look at the stellar catalogue of Ptolemy Claudius written a century and a half later we see a list of stars containing celestial latitude, longitude and a visual magnitude. Manilius' work is very different. As a philosophical and poetical artist writing at a conceptual level, Manilius may have regarded such formal enumeration of the sky as irrelevant to this work.

A curious lack in Manilius is the limited discussion of the role of the planets. The planets play a large role in astrological prediction, both in modern and ancient astrology. Yet, Manilius mentions them only in passing, in the context of discussing other celestial phenomena. This gap in Manilius' work has been used to suggest that part of it is missing, that it was not completed or that possibly Manilius attributed a lesser role to the planets. This question deserves further research. Manilius does give some information on the planets. He states the relative distance of the planets; furthest from the Earth is Saturn followed by Jupiter, Mars, Venus, Mercury and the Moon. Planetary retrograde motion is described as strange and "backward moving stars (planets)."

Manilius continues his narrative by describing the circles of the sky. Into this category he places the Zodiac, the Celestial Equator, the Milky Way, the tropics of Cancer and Capricorn and the Arctic and Antarctic Circles.

In his description of the Zodiac we receive a catalogue of the constellations and prominent stars. The zodiac is "from which the whole scheme of destiny is derived," a clear indication of its importance to an astrologer. On several separate occasions Manilius refers to the Zodiac as having "twice six" constellations. This form of enumeration harks back to the Babylonians demonstrating the ultimate source of Manilius' information. In the later books, describing astrological calculations in detail, the zodiacal constellations receive a far more in depth appraisal.

Lastly Manilius describes comets. Comets were considered evil and bringers of evil times in ancient and medieval society. The Roman author and Stoic Seneca, writing fifty years after Manilius in the reign of Nero, devotes a book/chapter of his Natural History to comets. He reports how comets are associated with Earthly disaster. Even Shakespeare's tragedy of Julius Caesar's mentions the ill effects of comets. Caesar's wife advises Caesar, on the Ides of March, that comets foretell "the death of princes."

Manilius tells us of the various theories of the origin of comets: that of Aristotle where comets are inflammable Earth vapours ignited by dry air; of Diogenes Apolloniates, where comets are wandering stars; or the Gods' means of warning humans of impending tragedy. The last is also Manilius' belief.

One very interesting point to be noted from book one of the Astronomica is a reference to Sirius's colour. A question as to the ancient colour of Sirius is occasionally discussed by modern astronomers.

Due to its brightness Sirius received a degree of popular prominence in ancient society. As its helical rising occurred in mid-July it came to be associated with summer heat. There are references to Sirius scorching fields, causing rabies (a "burning" disease) and being the bane of farmers.

Evidently Sirius's helical rising was regularly observed as its appearance allegedly foretold the health of the coming year. Due to scintillation Sirius's appearance at these times was that of a bright, flickering, red star. This visualisation of a "red" Sirius entered into the popular consciousness. A number of ancient authors, Homer, Horace, Cicero, Seneca and Ptolemy, have called Sirius red in their works. Manilius, however, clearly calls Sirius "blue-white" — its true colour.

Manilius also provides us with an outline of Roman Stoicism and Roman astrology. Astronomy places a secondary role.

In the "Astronomica" we uncover a different version and interpretation of ancient astronomical and astrological thought, rather than new knowledge. If Manilius' work had not survived, little would have been lost. This and his Latin have meant that his work has been little examined by classicists. However, there are so few astronomical works surviving from the ancient world that each must be closely examined to wring from it what information we can. After Manilius there were few remaining classical astronomer of note till the still surviving work of Ptolemy Claudius, c150 AD. His work, while of questionable veracity and partly astrological, summarised the astronomy of the ancients and was the basis for medieval Arabic astronomy. Ptolemy's work was not superseded till Copernicus and Kepler. The failures of Manilius as an astronomer in themselves tell us to what standing astronomy had de-

clined from the earlier Greek period. Manilius can at least reflect the work of other, more prominent, authors of his period.

Based upon my investigations into Manilius I feel that he was at least an active observer of the heavens. His work, while not great in itself, has some merit and worthwhile information and represents a large expenditure of time and energy. Its scope and complexity required many years of observation and composition. His work also allows us to better measure the works of other classical scientific figures.

Further Reading

General Discussions of Ancient Astronomy:

A well quoted authority is **A History of Astronomy**, by A. Pannekoek, Interscience Publishers, Inc., 1961.

A more exacting look at ancient astronomy comes from **The Exact Sciences in Antiquity**, by O. Neugebauer, 1957.

A detailed look at the "scientific" era of ancient astronomy can be found in **Early Greek Astronomy to Aristotle**, by D. R. Dicks, Thams and London, 1970.

For a "light" general text, look at **Astronomy of the Ancients**, edited by K. Brecher and M. Feirtag, MIT Press, 1980.

For those interested in reading further on Greece and Rome:

From Solon to Socrates, by Victor Ehrenberg, Methuen and Co.

History of Rome, by Michael Grant, Weidenfeld and Nicolson.

An introduction to Stoic philosophy as it relates to astronomy can be found in **The Stoic Tradition from Antiquity to the Early Middle Ages**, Colish, ML., pub. E. J. Brill, 1985.

For a description of the Epicurean scientific philosophy, read Lucretius' "De Rerum Natura", translated by W. Leonard, and S. Smith.

For a critique of Ptolemy's work, read **The Crime of Ptolemy Claudius**, by R. Newton, The John Hopkins University Press, 1977.

About the Author

Ian Bacon is a Masters student in Classics at the University of Western Australia. His Master's topic is an examination of Manilius from an astronomical viewpoint. Ian possess degrees in computer science, information technology, and Classics. Ian has worked at the Perth (Australia) Astronomical Observatory and as a computer programmer. Taking time to complete a Classics Masters is a long-term ambition of Mr. Bacon and one he thoroughly enjoys. His address is: P.O. Box 166, Scarborough, Australia, 6019. His E-mail address is: `ibacon@uniwa.uwa.edu.au`.

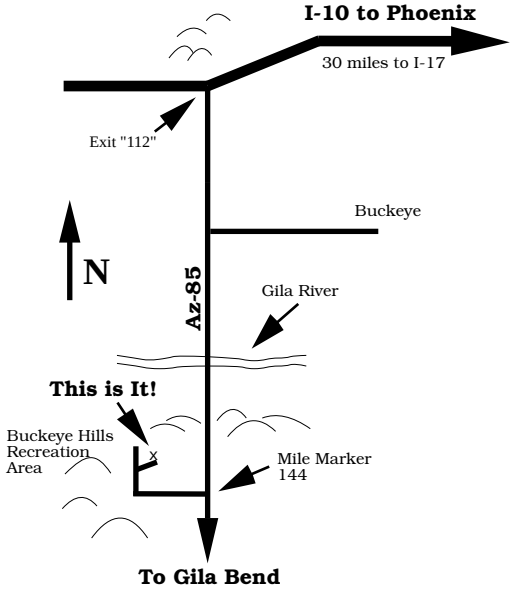
Newsletter Deadline

Mail items at least two weeks before the end of the month. Items arriving too late for an issue will be included in the next newsletter.

Directions to SAC Events

SAC General Meetings 7:30 PM at Grand Canyon University, Fleming Building, Room 105 — 1 mile west of Interstate 17 on Camelback Rd., north on 33rd Ave., second building on the right.

SAC Star Parties at Buckeye Hills Recreation Area



Interstate 10 west to Exit 112 (30 miles west of Interstate 17), then south for 10.5 miles, right at entrance to recreation area, one-half mile, on the right. No water and only pit toilets. Please arrive before sunset; allow one hour from central Phoenix.

SAC Deep Sky Subgroup Meeting at John & Tom McGrath's, 11239 N. 75th St., Scottsdale, 998–4661 — Scottsdale Rd. north, Cholla St. east to 75th St., southeast corner.

Bits and Pieces

Coming Events

The Lowell Observatory Tour is planned for Saturday, August 28. See the note on page 8 in this newsletters for more details.

Deep Sky Meeting

The Deep Sky Group is made up of people that like to observe celestial bodies out past the far reaches of our Solar System. These bodies include stars, nebula and galaxies. If you are interested in sharing your observations, or knowing what they look like in telescopes — then by all means come join us at the next meeting. We will discuss Deep Sky objects in Ophiuchus. The meeting will be held at John McGrath's house; directions are here in the newsletter.

Lowell Observatory Tour

Saturday, August 28

The Saguaro Astronomy Club will be touring Lowell Observatory in Flagstaff. Astronomer Brian Skiff will give us an insider's view of a very active observatory that is rich in history. A tentative itinerary includes visits visits to the 72-inch, 42-inch, and 31-inch telescopes on Anderson Mesa. This will be followed by a tour of Mars Hill, where we will see the 21-inch photometry telescope, the camera used to discover Pluto, one of the great astronomical libraries on the planet, and the photographic plate vaults. This is not the standard general public tour, so you won't want to miss it.

The tour will take place on Saturday, August 29. The bus will be leaving Phoenix at around 9:00 AM and will arrive back in town around 10:00 PM. Plan to bring a sack lunch for a picnic in Flagstaff.

Bus fare for the tour is $20. Please bring your check, made out to Saguaro Astronomy Club, to the next meeting or mail it to SAC Treasurer Carol Lee, 3314 N. 68th St. #205, Scottsdale, AZ 85251.

You don't need to RSVP, we don't extend special invitations to anyone — ourselves included. If you are interested show up, we'd love to have you.

The Deep Sky meeting will take place on Thursday, July 8 at 7:30pm.

E-Mail Roster

The Compuserve addresses are given in the Internet format: `nnnnn.nnn@compuserve.com` are really in the format `nnnnn,nnn` within Compuserve. GEnie addresses are accessible via the Internet for those paying for the mail service.

Bob Bryant	`Bob_Bryant@poncho.phx.sectel.mot.com`
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A J Crayon	`a.crayon@az05.bull.com`
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Minutes of the June Meeting

President Bob Dahl opened the June meeting at 7:35 PM with a welcome to all visitors and guests, inviting them to sign the guest book to receive the newsletter. The next SAC Star Party was going to be at Buckeye Hills on June 12. The Prescott Astronomy Club had invited our club to join them on June 19 for a Pot-Luck Star Party in Prescott. Bob asked for a show of hands to find out how many members would attend and bring their scopes. A map to the site was available on the table.

Carol Lee gave the Treasurer's Report and said that we now have 103 members. Tome Polakis updated the information about the Lowell Observatory bus trip on August 28. The cost for each person would be $20 and should be paid soon. Brian Skiff would be the contact person for the tour in Flagstaff. A.J. Crayon reminded members about the next Deep Sky meeting on July 8 at 7:30 PM at the McGrath's house. The discussion would be the objects in the constellation Ophiuchus. He then presented the Herschel 400 Award to Stan Student for meeting the observation requirements.

For the "Show'n'Tell" section of the program, Alex Vrenios presented some slides of the retrograde motion of Mars; Michael Janes show slides of the recent lunar eclipse; Tom Polakis and Rich Rotramel both had slides from the Riverside Telescope Maker's Conference, and Stan Student demonstrated the computer-generated images of various galaxies.

Following the break, David Levy talked about the break-up of the Comet Shoemaker-Levy.

—*Susan V. Morse, SAC Secretary*

July 1993

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
All Times are Mountain Standard Time				1	**SAC Meeting** 2	Full Moon Moon 4:45 p.m. 3
4	5	Tomorrow Saturn 7°S of Moon 6	**EVAC Meeting** Directions: Joe Murray 482-2918 7	**Deep Sky Meeting** 8	9	10
Last Quarter Moon 15:49 p.m. 11	Neptune and Uranus at opposition 12	13	Mercury in inferior conjunction 14	15	16	**SAC Star Party** Buckeye Hills (members & guests) 17
18	New Moon 4:24 a.m. 19	20	21	Mars 6°N of Moon 22	23	Jupiter 6°N of Moon (in a.m.) 24
First Quarter Moon 8:25 p.m. 25	26	27	28	29	30	31

Magazines & Discounts

Club members may subscribe to astronomical magazines at reduced rates through the club Treasurer. See the Member Services Form on the back page of this newsletter. Furthermore, club members are encouraged to align their subscriptions with the Jan.–Dec. calendar year. This eases the burden both on the Treasurer and the Publisher by permitting a single Group Renewal to be placed in the autumn for the upcoming calendar year.

Those members who experience problems with their subscriptions to *Astronomy* magazine may call Kalmbach Publishing Customer Service at (800) 446–5489.

Those members who experience problems with their subscriptions to *Sky & Telescope* magazine may call Sky Publishing at (800) 253–0245.

Besides the club discount on *Sky & Telescope* magazine, Sky Publishing offers club members a 10% discount on all other Sky publications. This means books, star atlases, observing aids, Spotlight prints, videos, globes, computer software, and more.

Club members who subscribe to *Sky & Telescope* through the Club Discount Plan may order Sky publications directly, at the above toll-free number, without going through the club Treasurer. Simply mention the Club Discount Plan and give the Saguaro Astronomy Club name to receive the discount. Sky Publishing will check their records to verify that you are eligible to receive the discount.

Saguaro Astronomy Club Member Services Form

Membership

Memberships are for the calendar year and are pro-rated as follows: Jan - Mar 100%, Apr - Jun 75%, Jul - Sep 50%, Oct - Dec 25%.

- ❑ $20.....Individual Membership
- ❑ $30.....Family Membership (one newsletter)
- ❑ $100.....Business Membership (includes advertising)
- ❑ $4.....Nametag for members
- ❑ $10.....Newsletter Only

Subscriptions

The following magazines are available to members. Subscribe or renew by paying the club treasurer. You will receive the discounted club rate only by allowing the treasurer to renew your subscription.

Sky & Telescope.....$20.00 for one year ❑

Astronomy.....$16.00 for one year ❑

Write your name, address, and phone number in the space below.

Make checks payable to SAC. Mail the completed form to:

Carol Lee
SAC Treasurer
3314 N 68th Street, #205-W
Scottsdale AZ 85251

SACNEWS
c/o Paul Dickson
7714 N 36th Avenue
Phoenix AZ 85051

Stamp

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