THE INTERNATIONAL COMET QUARTERLY

WHOLE NUMBER 49 JANUARY 1984 VOL. 6, NO. 1

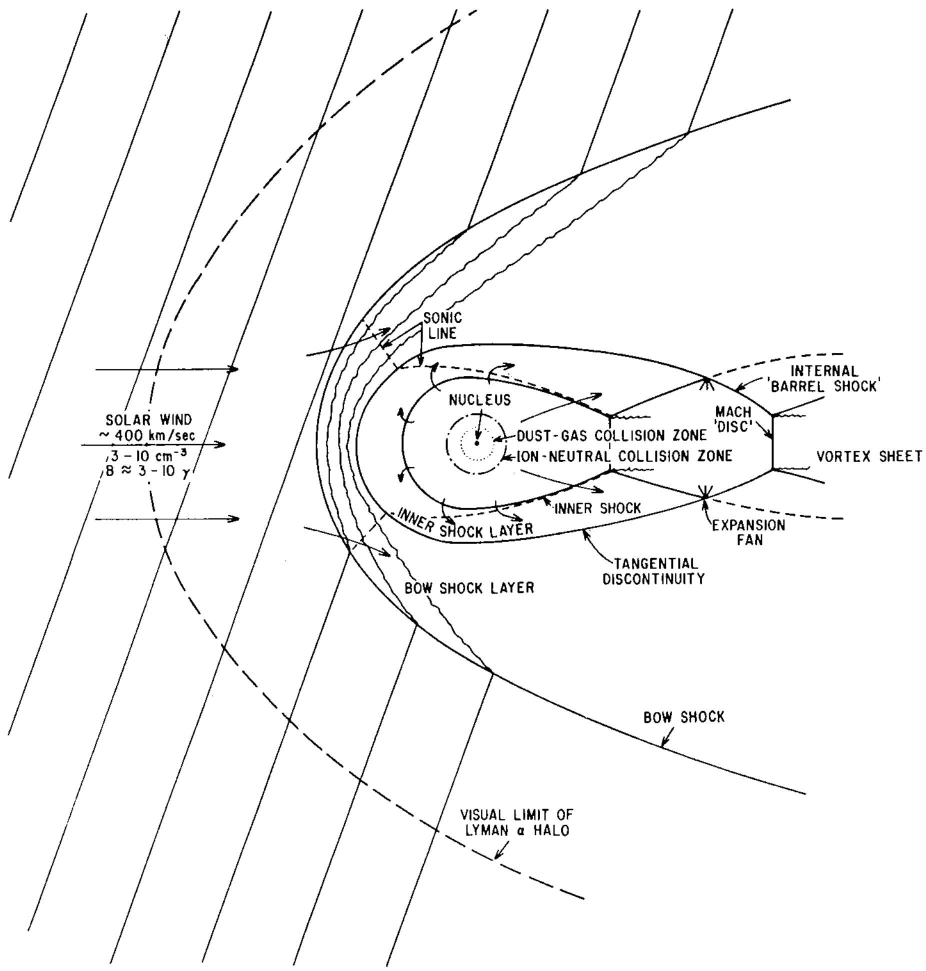

Figure 13 to "The Interaction of Comets with Solar Radiation and the Solar Wind" (see page 3): Schematic representation of the morphology of the solar wind interaction with the cometary atmosphere, giving the various flow regimes and flow discontinuities.

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Make checks or money orders payable in U.S. funds to INTERNATIONAL COMET QUARTERLY and send to Daniel Green; Smithsonian Observatory; 60 Garden St.; Cambridge, MA 02138, U.S.A. Group subscription rates and advertising rates are available upon request. Manuscripts will be reviewed for possible publication; send typed, double-spaced copy to the Editor (address above).

Cometary observations also should be sent to the Editor at the above address. Back issues are available from Dr. T. Rokoske; Dept. of Physics and Astronomy; A.S.U.; Boone, NC 28608, USA.

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FROM THE EDITOR

Beginning immediately, all individuals sending photometric observations of comets for publication in the ICQ should send them to the Editor. Please use the following address:

Daniel W. E. Green
Smithsonian Astrophysical Observatory
60 Garden Street
Cambridge, MA 02138, U.S.A.

Charles S. Morris has moved from Massachusetts to California, and it will not be practical to send observations to his old address (because delays will be inevitable). Observers who have recently sent observations to Mr. Morris at his old address can be assured that they will be forwarded to the ICQ office in Cambridge, but there may be some publication delays.

Although Mr. Morris will remain actively involved with the ICQ as Associate Editor, the initial handling of photometric observations, as well as current subscription transactions and all editorial material, will be handled by the Editor in Cambridge. To help in the processing involved with this, we welcome the addition to the Staff of our new Managing Editor, Angela C. Green.

Readers are also urged to note that the ICQ is still off of its publishing schedule by a couple of months. Many readers write continually to ask where the last issue has gone; if you are one of these readers, and you know that your ICQ subscription balance is positive, please be patient and refrain from asking about the current issue. We are working hard to push the publication schedule back to where it should be, but since this is a volunteer effort, simply be reassured that subscribers will receive all issues entitled to them.

-- Daniel Green (1/31/84)

THE INTERACTION OF COMETS WITH SOLAR RADIATION AND THE SOLAR WIND. III.

D. A. Mendis and Harry L. F. Houpis
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EDITOR'S NOTE: PART II OF THIS REVIEW PAPER WAS PUBLISHED IN THE LAST ISSUE. Corrigendum to Table I of this paper, p. 56 (July issue), bottom line of second column: CO should read CO_2.

VI. Modelling the Comet/Solar-Wind Interaction

Following Alfven's morphological MHD model of the solar-wind interaction with the cometary atmosphere, it was pointed out by Ian Axford that over distances that are large compared to the ion gyro-radii ($\leq$ 1000 km), the solar wind plasma may be regarded as a fluid, despite the fact that the collision-mean-free-paths of the particles are larger by many orders of magnitude. In a pioneering paper in 1967, Biermann, together with B. Brosowski and H. U. Schmidt, developed a detailed quantitative model of the solar-wind/comet interaction in the hydrodynamic approximation by treating the comet as a source of fluid within a streaming flow. The interplanetary magnetic field, while not introduced explicitly, was accounted for implicitly by taking the ratio of specific heats, γ, as 2. The instantaneous coupling of the cometary molecules, on ionization, to the solar plasma, is also taken to be a consequence of the interplanetary magnetic field.

Since the inflowing solar wind, treated as an inviscid, single fluid, is continuously changing in composition, due to incorporation of newly-created cometary ions, the usual equations for the change of momentum and energy are supplemented by two separate equations for the change of mass and particle number. It is immediately established that -- with a typical mass of a cometary ion being about 30 times the mass of a proton -- the rate of change in the mean molecular weight of the inflowing solar wind is the predominant controlling factor in this mass-accreting flow.

The basic features of the plasma flow near the comet are shown schematically in Fig. 13 (see p. 1). While a tangential discontinuity surface separates the purely-cometary plasma from the contaminated solar-wind plasma, a shock is anticipated by the time the mean molecular weight of the solar wind has increased, due to added heavy cometary ions, by about 33 percent. This corresponds to an addition of only about 1 percent cometary ions (CO II, N_2 II, H_2O II) to the solar wind, which is largely composed of protons.

The results of a typical computa-

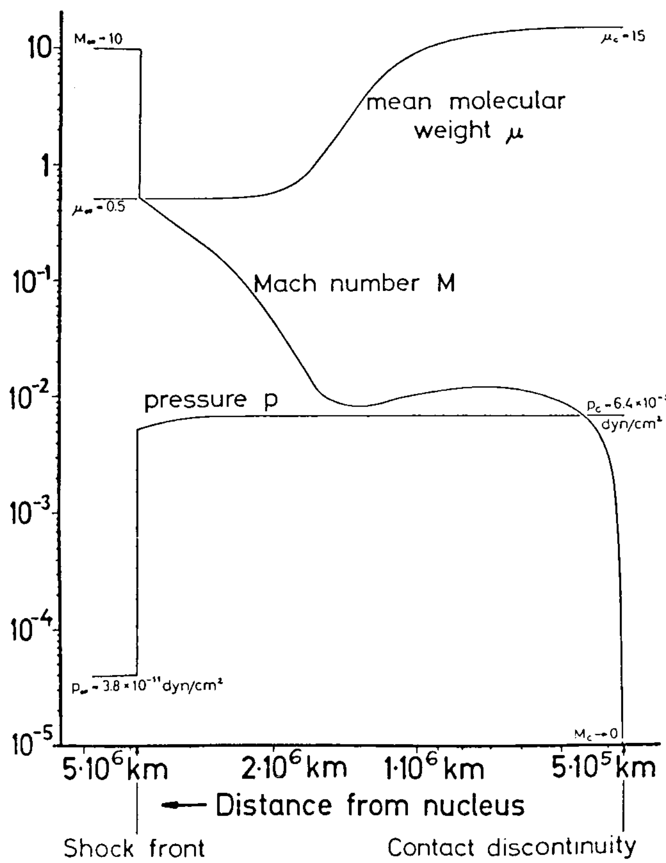

Figure 14. Model calculation of the solar-wind/cometary-atmosphere interaction for a neutral production rate = 10^{30} molecules/sec: variation of pressure (p), Mach number (M), and mean molecular weight (μ) outside the tangential discontinuity surface. (From Biermann et al. 1967, Solar Physics 1, 254.)

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tion, using a neutral-gas production rate from the nucleus of 10^{30} molecules/sec and a neutral-bulk velocity of 1 km/sec, are shown in Figure 14. It is also assumed that the undisturbed solar-wind bulk-velocity = 400 km/s and the undisturbed, upstream Mach number = 10. A strong shock is observed around 4 x 10^6 km from the nucleus, and the stagnation point is at about 4 x 10^5 km from the nucleus. The slight inversion of the Mach number around 1.5 x 10^6 km is caused by the rapid rise of mean molecular weight in that region, before the effect is finally overcome by the divergence of the flow. While these features are typical of all the models considered (with different values of the various parameters), the position of the tangential discontinuity surface is determined largely by the ratio of the momentum flux of the undisturbed solar wind and the momentum flux of purely-cometary plasma. Similarly, the position of the upstream shock discontinuity is strongly dependent on the ratio of the undisturbed mass flux in the solar wind and in the neutral cometary gas.

These calculations of Biermann and his co-workers have been criticized by Max Wallis, who has pointed out that, in certain situations, charge exchange and photo-ionization can proceed in such a way that the solar wind is gradually and smoothly decelerated from supersonic to subsonic velocities without any generation of a shock. A detailed calculation done by Wallis shows that an upstream shock does exist but that it is much weaker than the one calculated by Biermann et al., having a Mach number of 2 rather than 10. Wallis has also shown that both the shock and the tangential discontinuity are closer to the nucleus by about an order of magnitude.

Recently, Schmidt and R. Wegmann employed the full set of MHD equations to calculate the flow-profile exterior to the tangential discontinuity surface. Using appropriate curvilinear grids in their numerical calculations, they obtain a full, 3-dimensional, axisymmetric flow profile. While they recognize that the proper solar-wind/cometary-atmosphere interaction has 3 free surfaces (the outer bow shock, the tangential discontinuity surface, and the inner shock in the ionosphere), their restricted 1-free-surface (bow shock alone) treatment of the exterior flow assumes a fixed size and shape (a paraboloid) for the tangential discontinuity surface. Figure 15 exhibits the isobars, the iso-velocity, and the iso-density profiles of the axisymmetric calculation. Sudden shifting of the transverse interplanetary magnetic field by about 90 degrees over a period of a few hours is shown to result in iso-density contours which have a marked similarity to the observed streamer structure in comets.

Despite this, and not withstanding the impressive effort that has gone into these calculations, a number of highly-questionable assumptions, made in order to make their numerical scheme work, require that the quantitative predictions of the model be viewed with caution. Also, there are outstanding problems with the thermalization of the new com-

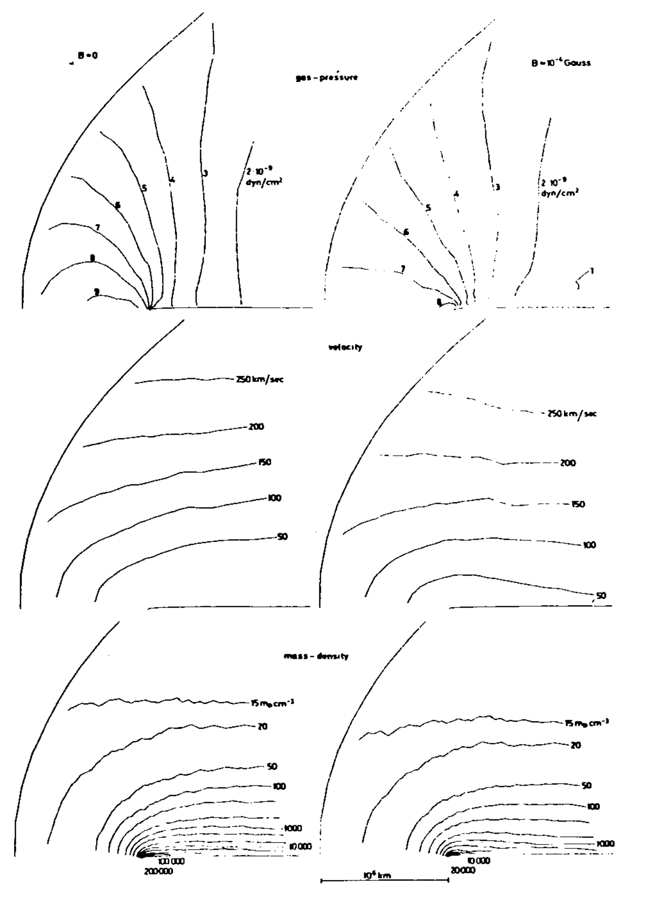

Figure 15. The solution of the MHD axisymmetric model of the cometary-atmosphere/solar-wind interaction, showing the isobars and the iso-velocity and iso-density curves. (From Schmidt and Wegmann 1981, in Comets, Univ. of Arizona Press, p. 538.)

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etary ions formed in the solar wind, which call into question the whole single-fluid MHD approach. Finally, it has been shown by Houpis and Mendis that the nature of the solar-wind interaction with the cometary atmosphere is highly variable, depending largely on the variable ram pressure of the solar wind. Consequently, the model described above is not universally valid. These authors have also shown that, under certain circumstances, the cometary neutrals, which play such a crucial role in the deceleration of the solar wind, cannot penetrate the tangential discontinuity surface to interact with the solar wind ahead of it. The solar wind is then decelerated by a strong shock of Mach number ~ 10, rather than by the weak one of Mach ~ 2 present at other times.

None of the predicted discontinuity surfaces has so far been observed from the ground-based observations. Their verification will have to await the in situ measurements of comet Halley during the upcoming missions to it in 1986. In the meantime, much work remains to be done on the physics of the solar-wind interaction with the cometary atmosphere if we are to properly anticipate these measurements.

So far, we have considered only the interaction of the solar wind with a well-developed cometary atmosphere. However, on account of either (a) being sufficiently far from the sun or (b) having its surface layers strongly depleted of volatiles, a comet may not develop a sufficiently dense atmosphere to present an extended obstacle to the inflowing solar wind. While this point was, no doubt, recognized for a long time, the first detailed analysis of this problem was carried out only recently by Mendis, Houpis, Jay Hill, and Elden Whipple.

These authors considered an H_2O-dominated comet at heliocentric distances ≥ 5 AU. It was shown that both the solar UV radiation and the solar wind have direct access to the nuclear surface, unimpeded by collision with cometary neutrals and ions or cometary ion pickup. Under these conditions, the combined effect of the solar wind and the solar UV radiation is to cause differential electric charging of the unprotected cometary nucleus. The authors showed that, while much of the sunlit surface is charged positively to small electrostatic potentials, it becomes negative close to the limb. On the other hand, numerically-very-large negative potentials (~ -1 kV) can be achieved on the night side. One important consequence of this electrostatic charging of the nucleus is that fine, loose dust on it can be electrostatically levitated and even blown off the surface. The authors conclude that a comet may lose up to about 10 cm of its surface per solar passage due to this process. If this is indeed true, then this could constitute the largest source of fine dust in the outer solar system. While an observational confirmation of this process is still needed, it has been pointed out that the large output of dust from comet Bowell 1980b beyond $r = 7$ AU, when no accompanying gas was seen, may make this comet a promising candidate.

Finally, the interaction between the solar wind and the comet that takes place between these two extremes (i.e., that of a very active coma and that of an optically-very-thin coma) has not been studied at all so far. Yet this is the range (2.5 AU $\leq r \leq$ 5 AU) that cometary activity is first detected for many comets. Consequently there is a pressing need for such a study. Furthermore, from the point of view of the comparative study of solar wind interactions with solar-system bodies, this would form an important, new area. The problem, however, is by no mean trivial, and several aspects need to be considered.

In the case of an H_2O-dominated comet, as it approaches the sun inside 5 AU, the surface-charging scheme proposed by Mendis <u>et al</u>. is invalid. The return currents produced by the fledgling cometary ionosphere will lead to a progressive discharging of the nucleus. Also, the production rate of the neutrals will not overwhelm the ionization rate beyond about 3 AU. Consequently, the degree of ionization in the rudimentary cometary atmosphere could be larger than when it is closer to the sun. Furthermore, with a relatively-small cometary ionosphere, the finite solar wind proton gyroradius has to be taken into account. Under these circumstances, it is difficult to imagine an impenetrable tangential discontinuity surface separating the contaminated solar wind from the cometary ionosphere. What would exist is a continuous transition from less-contaminated to more-contaminated solar wind all the way up to the surface.

While all the cometary ions will initially be dragged away to form a supersonic wake, as their production rate increases with decreasing heliocentric distance, the loading of the solar wind would become sufficient to cause its flow to become transonic ahead of the comet. Consequently, a solar-wind bow shock is expected to form well before a tangential discontinuity surface. Also, in this case one expects the entire region between the outer shock and the cometary surface to be initially subsonic, although the solar-wind pressure will eventually become insufficient to prevent the supersonic outward expansion of the cometary gases. It would also be interesting to know exactly when this transition occurs. Finally, sputtering by the solar wind ions may be important to the formation of cometary atmospheres in this transition region, and this needs to be investigated. The dust-gas coupling in this region could be relatively more important to the dynamics of the cometary gas, and this, too, would tend to extend the region of subsonic flow within the cometary atmosphere.

VII. CONCLUSIONS

In this paper, we have briefly reviewed our present knowledge and understanding of the interaction of solar radiation and the solar wind with comets. As would be obvious to the reader, there is now a substantial body of knowledge on the subject, and it has been growing rapidly in recent years. However, our present understanding of the subject is less substantial and more insecure.

Even such fundamental questions as the dominant molecules in the inner coma, the dominant ionization mechanisms, the nature of the coupling between the solar wind and cometary atmosphere, and the morphology of the induced cometary magnetosphere still remain more or less open, despite the considerable effort that has been directed toward their resolution. When it comes to the complex and time-varying phenomena observed in the plasma tails, our present understanding is highly speculative.

There is little doubt that, with the in situ observations of comet Halley during the coming 1986 flybys of several space probes, both our knowledge and our understanding of cometary phenomena will increase dramatically. But if we are to make best use of these observations, our theoretical modelling of cometary atmospheres and the solar-wind interaction with them should improve substantially between now and then.

VIII. SELECTED BIBLIOGRAPHY

(1) For a more detailed and comprehensive recent review of this subject, the reader is referred to the following article:

"The Cometary Atmosphere and its Interaction with the Solar Wind", D. A. Mendis and Harry L. F. Houpis 1982, Reviews of Geophysics and Space Physics, 20, pp. 885-928.

(2) The following chapters in the book Comets (ed. by L. L. Wilkening; Univ. of Arizona Press, Tucson, 1982), are also recommended for further reading:

- (a) "Overview of Comet Observations" -- S. Wyckoff
- (b) "Chemical Composition of the Cometary Nuclei" -- A. H. Delsemme
- (c) "Observation and Dynamics of Plasma Tails" -- J. C. Brandt
- (d) "Theories of Physical Processes in Cometary Comae and Ion Tails" -- W.-I. Ip and W. I. Axford

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CORRECTION: On the cover of the 1983 October issue, "WHOLE NUMBER 47" should read "WHOLE NUMBER 48". The correct number was stated on the second page of that issue.

TWO-BOOK REVIEW: LIMITS OF LIFE, and COMETS AND THE ORIGIN OF LIFE

Limits of Life, ed. by C. Ponnamperuma and L. Margulis, D. Reidel Publ. Co., 190 Old Derby St., Hingham, MA 02043, U.S.A.; 210 pp., ISBN 90-277-1155-0, $26.50 clothbound, 1980.

Comets and the Origin of Life, ed. by C. Ponnamperuma, D. Reidel Publ. Co., 289 pp., ISBN 90-277-1318-9, $39.50 clothbound, 1981.

Limits of Life and Comets and the Origin of Life are the proceedings of the Fourth and Fifth College Park Colloquia on Chemical Evolution, respectively, which were held in October 1978 and October 1980. Cyril Ponnamperuma has been editing the proceedings of these colloquia, the first three being held during 1974-76 on the subjects of the Giant Planets, Early Life during the Precambrian, and Comparative Planetology. The two present volumes lend intriguing insights into the questions concerning the early evolutionary states of life. Both books have good indices, and Comets and the Origin of Life includes a convenient listing of the Colloquium participants with their postal addresses.

Limits of Life gives an interesting outline of the environmental studies concerning the origin of life on earth. Authors present discussions of primitive and evolving life forms under cold and hot temperatures, under different pressures, and in different types of aquatic and atmospheric environments. Michael J. Newman has written a short chapter on the historical behavior of the sun, and, in particular, on the variability of the solar "constant" -- the rate at which solar energy is received by the earth per unit area per unit time.

A good knowledge of geology is important to gain much information from many of the 16 papers included in Limits of Life. A most interesting paper for a layman to peruse is that by Andrew Knoll of Oberlin College; his unusual writing style includes the following two quotes which are applicable to the subject matter of the entire book: "Nothing is harder, yet nothing is more necessary, than to speak of certain things whose existence is neither demonstrable nor probable" (Hermann Hesse), and that by William Smith, who in 1859 wrote that "if man was to think beyond what the senses had given him, he must first throw some wild guesswork into the air, and then, by comparing it bit by bit with nature, improve and shape it into truth." Knoll's paper includes a table of lake and sea beds throughout the world during the period 1800-2600 m.y. (presumably million years) ago, listing location, age, tectonic setting, and notable features (such as coal, gold, etc.).

Comets and the Origin of Life includes 17 papers and a separate bibliography listing 168 references to publications concerning the topic of the book itself. The chief topic covered under Comets and the Origin of Life is itself highly debatable. Fred Hoyle and Chandra Wickramasinghe have been champions of the idea that comets carry biological molecules capable of influencing the evolution of life on earth, and the two scientists carry their argument through one of the book's chapters. A. Lazcano-Araujo and J. Oro come very close to joining Hoyle's bandwagon, while Donn Kushner counters fairly strongly against comets being carriers of life. Most authors modestly take to the "middle-of-the-road" and ask the question, "What if?" J. Mayo Greenberg, who has done extensive studies on the relationship between comets and the interstellar medium, states his belief that passage of the solar system through a dense interstellar cloud is much more likely to affect the evolution of terrestrial life than are comets. A. H. Delsemme notes that comets may have contributed to the development of terrestrial chemistry, and that, "at least in the present state of our ignorance," it may seem attractive to put the origin of life in space.

Some contributing scientists concentrate on some aspect of their work in their articles in Comets and the Origin of Life, and do not get involved with the question of life (for example, D. A. Mendis and his "Interaction of Comets with the Interplanetary Medium"; P. D. Feldman's "Ultraviolet Spectroscopy of Comets"; and M. F. A'Hearn's "Chemical Abundances in Comets"). These reviews contribute well to the subject matter of the book, however.

F. L. Whipple's overview entitled "The Nature of Comets" is properly positioned as the first article of Comets and the Origin of Life, and other topics which are covered include a short review of the cometary nucleus (by B. Donn), "Chemical Kinetics im [sic] the Coma" (by W. F. Huebner), and space-probe missions to comets (in particular, P/comet Halley).

While Limits of Life is neatly typeset, this second book was apparently made from typewritten copy supplied directly by the individual authors; although the overall layout of Comets and the Origin of Life is neat, the widely-varying typeface from article to article is very noticeable. Some of the typewritten text in this second book is not very neat, and there are some errors present. One example is that the reference to Whipple (1978) on line 5 of page 126 is not given in the list of references at the end of Greenberg's paper. The book is not overflowing with photographs (only 4 of the articles include any photos), and authors rely heavily on many graphs and tables to illustrate points.

In closing, Comets and the Origin of Life is a good book to add to one's library of books on comets, as there are some noteworthy items discussed here that are not easily found elsewhere. The rather steep price, however, may not be worth the purchase for the layman.

-- Daniel W. E. Green

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BOOK REVIEW: COMETS

Comets, ed. by L. L. Wilkening, 775 pp., $29.95 hardbound, Univ. of Arizona Press (1615 E. Speedway Blvd., Tucson, AZ 85719, U.S.A.), 1982.

This book is a "must" -- it should be on the book shelf of any amateur or professional astronomer interested in comets. Comets is one of an excellent series of books published by the University of Arizona Press concerning various solar system topics. (We plan to review soon another book in the series: Asteroids.)

Comets is not a book for the general layman with little knowledge of astronomy, science, or comets. It does assume some knowledge in these subjects, but any professional or advanced amateur astronomer will gain much useful information from this volume. This reviewer has yet to see a really good introductory book on comets which is both up-to-date and on the reading level of, say, Sky and Telescope, with just the right amounts of historical and technical material. Comets is a completely different type of book.

This book is essentially the proceedings of IAU Colloquium No. 61, known as "Comets: Gases, Ices, Grains and Plasma", which was held in March 1981 in Tucson, Arizona (see Charles Morris' article on p. 35 of the April 1981 issue of the ICQ). Twenty-nine articles are presented by specialists in their respective fields of cometary studies.

Most of the top experts in cometary studies were present at the Tucson meeting, and Comets amply reflects this through its papers. There are eight sections in the book, beginning with one that contains an "Overview of Comet Observations" by S. Wyckoff and a discussion of "Comet Discoveries, Statistics, and Observational Selection" by L. Kresak, both of which are very informative. Part II contains eight articles concerning the cometary nucleus, and includes such topics as split nuclei, chemical and physical composition and structure, and the relationships of comets to meteorites.

Part III includes 5 papers concerning cometary dust, and Part IV discusses the coma via five more articles. A paper by D. Meisel and C. Morris on comet photometry includes discussion of visual observations published in the ICQ. Part V has four papers on "Ion Tails and Solar Wind Interactions", and Part VI includes the same number of articles on "Origin, Evolution, and Interrelations" of comets. A very valuable article by B. Marsden and E. Roemer is published in the Appendix (Part VII), listing "Basic Information and References" in a very readable and non-technical format. The Appendix includes information on how to report a comet discovery, how to reduce photographs for astrometric positions of comets, and how to compute an ephemeris from given orbital elements. One convenient table in this article lists original and future values of 1/a for long-period comets, and another table lists predicted orbital elements of short period comets up to the year 2000.

The final part of Comets includes a lengthy Glossary of terms, a list of the Colloquium participants, and an index.

Comets is produced in a very attractive manner; it includes a readable, typeset text. However, many errors crept into the text, some probably due to the authors, some due to the publisher. Since the book is a superb reference, I list some of the problems that I have found or that have been pointed out to me, to make the book more complete and correct for the reader.

1) On page 59, the line just above Fig. 2 should read "1700 A.D." instead of "1700 B.C."
2) On p. 104, comet Ikeya-Seki 1968 I is incorrectly termed a sungrazing comet.
3) The index is not as strong as it could be. E.g., nongravitational forces on pp. 94, 205, 209ff, 719, and 723 should have been included therein.
4) Figure 4 on p. 100: the data are NOT logarithmic values as the headers suggest.
5) A period was left off the first sentence on p. 480.
6) P. 378 should be p. 379, and vice versa.
7) On p. 167, Table I is in degrees K.
8) On p. 147, line 5 from the bottom, "Beckler" should read "Becklin".
9) The first sentence of the third paragraph on p. 151 is so garbled as to be meaningless.
10) Delsemme's second sentence on p. 88 leaves the reader wondering.
11) The abbreviations used by F. Whipple in his Tables III and IV are especially annoying. Comets P/Harrington and P/Shajn-Schaldach become "Haring" and "Sch-Sch", for example.
12) The title of the paper by J. Degewij and E. Tedesco, "Do Comets Evolve into Asteroids?" becomes "Do Comets Evolve around Asteroids?" for the running title on 14 pages!
13) The top line of p. 324 is missing a number: "between 0.1 and times the..."
14) Table II of Donn and Rahe, listing sungrazing comets, should have included comet 1970 VI. One could now also add the 3 SOLWIND comets reported recently.
15) On p. 97, comet Morehouse "1980 III" should read "1908 III".

The remaining comments all refer to the Glossary:

1) No definition here (nor anywhere else in the book) of atomic/molecular transitions which appear on pp. 25-28, 30, 100-1, 439-451, 464-5, and 482-7, or of how spectra of comets are obtained (subtracting sunlight and the earth's atmosphere would be important information for the reader of this book, for example).
2) The term "centimeter-Amagat" is not defined on p. 739.
3) Under the definition for nuclear magnitude (p. 745), the last sentence should read, "In practice, published nuclear magnitudes DO include an unknown component of light from an unresolved coma." And, under "total magnitude" (p. 750), the tail is NOT usually considered as part of this definition, although a small contribution from the tail close to the coma may at times be present in practice.
4) Note that meteoroids do not necessarily orbit the sun "in the vicinity of Earth" (p. 745).
5) The definition under "comets, nomenclature" (p. 740) is poor. Nothing is mentioned of comet recoveries, and it is certainly ambiguous to say, "Frequently the discoverer's name precedes the designation."

These are only some of the errors and problems present in Comets, and this reviewer's comment would be that more review of the text should have occurred before publication. Indeed, one using this book should be aware that so many careless errors are spread throughout the book. However, do not let these problems prevent the use of this excellent scientific book. Comets is a good representation of the studies that are currently being done on comets, and it is an extremely good source of information on a wide variety of topics.

-- Daniel W. E. Green

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BOOK REVIEW: APPLICATIONS OF MODERN DYNAMICS TO CELESTIAL MECHANICS AND ASTRODYNAMICS

Applications of Modern Dynamics to Celestial Mechanics and Astrodynamics, 391 pp., ed. by V. Szebehely, $43.50 clothbound, ISBN 90-277-1390-1, D. Reidel Publishing Co., 1982.

This volume contains 54 papers by some 60 authors, and represents the Proceedings of the NATO Advanced Study Institute held in August 1981 at Cortina d'Ampezzo, Italy. The editor, Victor Szebehely, is a well-known celestial mechanician at the University of Texas. Applications of Modern Dynamics to Celestial Mechanics and Astrodynamics is on a highly-technical level, and is intended largely for graduate students of dynamical astronomy or other specialists in the field.

Two of the papers are in French, the remainder being in English. Nineteen of the papers presented at the Study Institute are published in full here, while 35 papers are given in abstract form only. The papers are divided into six sections: 1) Stars, Planets, Satellites, Asteroids and Rings (8 papers); 2) Resonance (2 papers); 3) Connection with Statistical Mechanics (2 papers); 4) Regularization and Geodesics (3 papers); 5) Non-Linearity, Determinancy and Manifolds (4 papers); and 6) The Abstracts.

Celestial mechanics is one vital discipline in astronomy that is severely neglected in graduate schools today. While this conference proceedings would not suffice, in the opinion of this reviewer, as a text for a graduate-level celestial mechanics course, it does include some interesting articles.

A paper by K. Aksnes, "The Dynamics of Close Planetary Satellites and Rings", reviews the history of theories concerning the rings of Jupiter, Saturn, and Uranus. Aksnes' historical account includes discussion of observations and ideas of Galileo, Huygens, Cassini, Kant, Roche, and Kirkwood, as well as studies made during the last 20 years by various astronomers and discussion of the Voyager flybys. While his listing of Saturnian satellites is already outdated, Aksnes presents a readable account of the rings, and, to a lesser extent, those solar system moons which are close to their planets.

Other noteworthy studies presented in Applications of Modern Dynamics to Celestial Mechanics and Astrodynamics include "Perturbations in Stellar Paths" by P. van de Kamp, and "Modern Lunar Theory" by J. Kovalevsky. The former discusses historical, observational, and theoretical aspects of the study of orbital motion of binary stars; the latter gives the reader a feeling for what is involved in studying the motion of the earth's Moon.

Many subjects which could be covered in a book with this title were not. In particular, a discussion of the motion of comets, with special attention to nongravitational forces, would be a valuable addition. This book may be an asset to a university's astronomy library, but few individuals would want to invest in this very specialized book. This reviewer questions the soundness of the publishing of the large number of books containing the proceedings of so many astronomical meetings as is being done today; too many books are being published with too many specialized papers that will be read by too few people. The publishing of Applications of Modern Dynamics to Celestial Mechanics and Astrodynamics is questionable for these reasons. -- Daniel W. E. Green

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NEWS NOTE: Third American Workshop on Cometary Astronomy to be held in Tucson, AZ, in June 1985. Further details soon.

FROM THE ASSOCIATE EDITOR

As of January 15, Prospect Hill Observatory closed its doors in Harvard, Massachusetts. After nearly six years of observing from Harvard, I have moved to southern California to take a position at the Jet Propulsion Laboratory (JPL) in Pasadena (just north of Los Angeles). While my new work is not directly related to astronomy (I will be working on oceanic studies), I expect to take advantage of JPL's extensive interest in astronomical research where possible. As noted on page 2 of this issue, observers should now send observations directly to the Editor, Daniel Green, in Cambridge. For those people wishing to correspond with me, my address at JPL is given below. Please do not include ICQ or Prospect Hill Obs. in the address.

Charles S. Morris
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Jet Propulsion Laboratory
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Pasadena, CA 91109, USA

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ROMAN NUMERAL DESIGNATIONS OF COMETS IN 1982.

The following tabulation continues that in ICQ 5, 26. In accordance with traditional practice, the single Roman numeral 1982 II is given to both components of P/du Toit-Hartley, of which what appeared to be the primary component received the preliminary designation 1982c, while the secondary component was 1982b. Comet 1982 X (P/Gunn) had no preliminary designation, as it generally is considered observable throughout its entire orbit.

Comet	T		Name	Year/letter	Ref.
1982 I	Mar.	12.3	Bowell	1980b	MPC 8051
1982 II	Mar.	30.4	P/du Toit-Hartley	-	MPC 6890
1982 III	May	9.3	P/Peters-Hartley	1982h	IAUC 3715
1982 IV	May	15.0	P/Grigg-Skjellerup	1982a	IAUC 3659
1982 V	July	30.6	P/Väisälä 1	1981l	IAUC 3654
1982 VI	Aug.	24.7	Austin	1982g	MPC 8051
1982 VII	Sept.	14.3	P/d'Arrest	1982e	IAUC 3697
1982 VIII	Nov.	12.1	P/Churyumov-Gerasimenko	1982f	IAUC 3743
1982 IX	Nov.	23.2	P/Russell 3	1983i	MPC 8386
1982 X	Nov.	26.9	P/Gunn	-	MPC 7773

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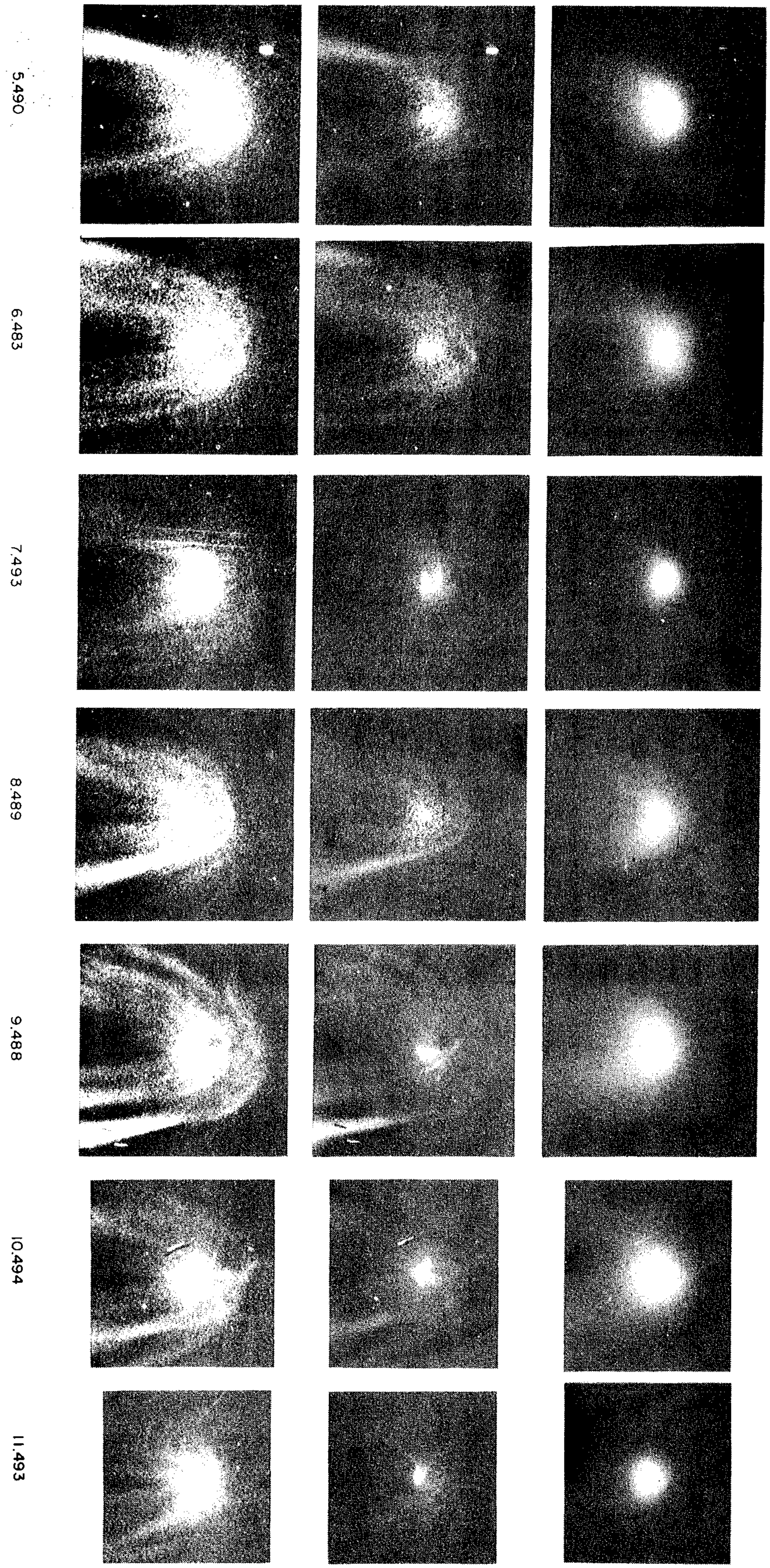
NEW IMAGE PROCESSING TECHNIQUES APPLIED TO 1910 PHOTOGRAPHS OF P/HALLEY

On the following 2 pages are a series of photographs which were taken with the 152-cm f/5 reflector at Mount Wilson in California. The original high-resolution photographs were using the following exposure times, beginning with 1910 May 5.49 UT and progressing to the 12th image on June 6.22: 8 min; 4; 4; 8; 8; 2; 2; 12; 25; 25; 20; 9. These 12 plates were slected by S. M. Larson (Lunar and Planetary Laboratory, University of Arizona) and Z. Sekanina (Jet Propulsion Laboratory) for a study of "Coma Morphology and Dust-Emission Pattern of Periodic Comet Halley" (to be published in the Astronomical Journal, April 1984). Larson and Sekanina utilize a new image-processing technique to draw out subtle features in the coma of periodic comet Halley. They note that "the most striking features are spiral jets that 'unwind' from the central condensation and evolve into expanding envelopes on a time scale of days."

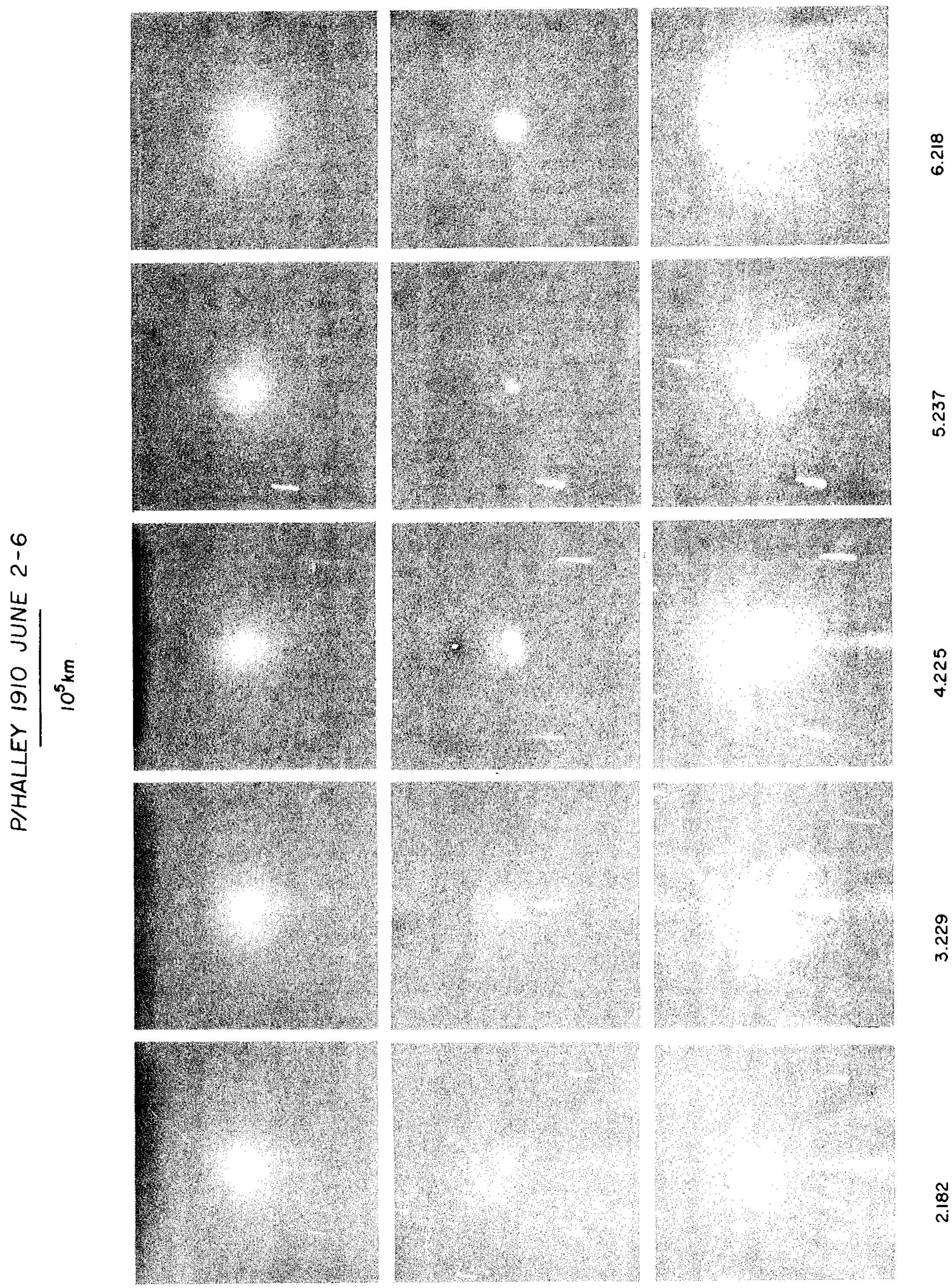
Each column represents the appearance of P/Halley at a specific time. The top row shows the original images, and the middle and bottom rows show the digitally-processed images (reproduced at two different display contrasts). All images are oriented such that the sun is toward the top of each photograph, and each frame is reproduced such that one side equals 180 000 km at the comet. We thank the authors and the Astronomical Journal for permission to publish these figures here.

ORIGINAL PLATES BY G.W.RITCHEY, MT WILSON OBSERVATORY
IMAGE PROCESSING AT THE LUNAR AND PLANETARY LAB, UNIV OF ARIZONA



P/HALLEY 1910 MAY 5-11

10^5 km



ORIGINAL PLATES BY G.W. RITCHEY, MT. WILSON OBSERVATORY
IMAGE PROCESSING AT THE LUNAR AND PLANETARY LAB, UNIV. OF ARIZONA

TABULATION OF COMET OBSERVATIONS

The headings for the tabulated data are as follows: "DATE (UT)" = Date and time to hundredths of a day in Universal Time (see p. 19 for explanation of UT). "MM" = the method employed for estimating the total visual magnitude (B = Bobrovnikoff, E = Beyer, I = In-focus, M = Morris, S = Sidgwick or In-out; also, P here stands for photographic magnitude, and photoelectrically-determined values fall under L, U, and V for the standard U, B, and V, respectively, with photoelectric V assumed for "W"). "MAG." = total visual magnitude estimate; a colon (:) indicates that the observation is only approximate, due to bad weather conditions, etc. "RF" = reference for magnitude estimates (see page 64 of the July 1982 issue). "AP." = aperture in centimeters of the instrument used for the observations, usually given to tenths. "T" = type of instrument used for the observation (cf. ICQ 2, 26 and 4, 64). "F/" and "PWR" are the focal ratio and power or magnification, respectively, of the instrument used for the observation. "COMA" = estimated coma diameter of the comet in minutes of arc. An ampersand (&) indicates an approximate estimate. "DC" = degree of condensation on a scale where 9 = stellar and 0 = diffuse; a slash (/) indicates a value midway between the given number and the next-higher integer. "TAIL" = estimated tail length in degrees; again, an ampersand indicates a rough estimate. "PA" = estimated measured position angle of the tail in degrees (north = 0, east = 90). "OBS" = the observer who made the observation (see below). An asterisk between the DATE and MM columns indicates that the observation is an updated version of one already published in a previous issue of the ICQ, THE COMET QUARTERLY, or THE COMET.

A complete listing of the Observer Key (as published during the past 5 years in the ICQ), the Reference Key, the Source Key, and the Instrument Key, is available as a computer printout from the Editor for $2.00 postpaid. Unfortunately, the length of the Observer Key (now some 500 observers) does not permit us to republish it in the ICQ in the near future; the entire set of Keys will be republished sometime within the next 3-5 years.

Listed in this issue are observations made by Albert Jones of New Zealand, an observer who has been making valuable photometric visual observations of comets since the mid-1940s. We have asked Mr. Jones to supply us with a complete listing of all his comet observations, and published here is the first set which he has sent us. Note that many of the observations published below are updated data of those published previously in the ICQ (especially in ICQ 41, which included observations made by Jones which were obtained second-hand from the British Astronomical Association); these replacement observations are denoted by an asterisk (*), as usual.

Also listed below are some observations of comet West 1976 VI = 1975n which were sent to us as per our request in ICQ 3, 8. Many of the observations sent to us have been very incomplete concerning the data we prefer to allow publication in the ICQ. We publish here again (page I-3) the report form which we ask all observers to use for reporting comet observations to the ICQ. Many observers will have to resubmit their Comet West 1976 VI data.

We encourage all observers (who have not already done so) to send their full observations for any comets observed since 1975 for publication in the ICQ in a future issue. Our goal is to build a comprehensive and accurate data base of photometric observations of comets going as far back in time as possible. There are many more careful observers making total visual magnitude estimates of comets today than there were 10 years ago, and we are building a valuable data base of observations of recently-observed comets. Those now making significant contributions to the data base will also ensure that a reliable light curve of P/Halley will be obtained at the current apparition.

Comet Jones (1946 VI = 1946h)

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1946 08 06.76		9 :		14	R	16	42					JON
1946 08 07.76	S	9	V	14	R	16	42					JON
1946 08 10.75	S	9.1	V	14	R	16	42					JON
1946 08 15.75	S	8.5	V	14	R	16	42					JON
1946 08 29.74		8 :		14	R	16	42					JON
1946 08 31.74		8 :		14	R	16	42			0.02	235	JON
1946 09 01.72	S	7.8	V	14	R	16	42				200	JON
1946 09 02.72	S	7.8	V	14	R	16	42					JON
1946 09 04.73		7.5:		14	R	16	42			0.06	210	JON
1946 09 07.70				14	R	16	42			0.02	243	JON
1946 09 10.74				14	R	16	42			0.02	245	JON
1946 09 15.71		7.5:		14	R	16	42			0.02	230	JON
1946 09 19.72				14	R	16	42			0.03	230	JON
1946 09 21.71				12.7	L	15	36			0.05	260	JON
1946 10 03.69		7 :		14	R	16	42			0.03	240	JON
1946 10 07.68		8 :		14	R	16	42			0.02	240	JON

Comet Rondanina-Bester (1947 IV = 1947b)

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1947 04 26.74	S	5.0	Y	5.0	B		2					JON
1947 04 26.74				12.7	L	15	36	3	5	0.75	180	JON
1947 04 29.75				14	R	16	42	3	5	0.75	180	JON
1947 04 29.75	S	5.1	Y	5.0	B		2					JON
1947 04 30.75				14	R	16	42	3	6	0.33	182	JON
1947 04 30.75	S	5.3	Y	5.0	B		2					JON
1947 05 05.74				14	R	16	42	3.5	6	0.23	182	JON
1947 05 05.74	S	6.0	Y	2.8	R	10						JON
1947 05 07.72	S	5.1	V	2.8	R	10						JON
1947 05 07.72				14	R	16	42	3	6	0.25	190	JON
1947 05 08.73				14	R	16	42	3	6	0.17	195	JON
1947 05 08.73	S	4.9	V	2.8	R	10						JON
1947 05 09.74	S	4.9	V	2.8	R	10						JON
1947 05 09.74				14	R	16	42	4	6	0.58	192	JON
1947 05 11.73	S	4.7	V	2.8	R	10						JON
1947 05 11.73				14	R	16	42	5	6	0.67	193	JON
1947 05 16.75				14	R	16	42	4	7	1	204	JON
1947 05 16.75	S	5.2	V	2.8	R	10						JON
1947 05 17.74	S	5.6	V	2.8	R	10						JON
1947 05 17.74				14	R	16	42	3.25	6	1.33	208	JON
1947 05 20.75	S	5.4	V	2.8	R	10						JON
1947 05 20.75				14	R	16	42	3.5	7	>1	210	JON
1947 05 23.75				7.5	R	12	18			2		JON
1947 05 23.75				14	R	16	42	4.5	7	>1	220	JON
1947 05 23.75	S	5.2	V	5.0	B		2					JON
1947 05 29.75				14	R	16	42	& 5	7	0.67	235	JON
1947 05 29.75	S	5.8	V	5.0	B		2					JON
1947 05 30.77	S	6.3	V	2.8	R	10						JON
1947 05 30.77	S	6.0	V	5.0	B		2					JON
1947 05 30.77				14	R	16	42	3.5	6	0.33	232	JON
1947 06 01.77	S	5.9	V	5.0	B		2					JON
1947 06 01.77				12.7	L	15	36	3	6	0.37	230	JON

Comet Rondanina-Bester (1947 IV = 1947b) Cont.

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1947 06 02.78	S	6.6	V	14	R	16	42		5	0.33	235	JON
1947 06 04.79	S	6.6	V	14	R	16	42	2	5	0.10	230	JON
1947 06 07.78	S	6.5	V	14	R	16	42	2	4	0.07	240	JON
1947 06 19.78	S	7.8	V	14	R	16	42	2	4	0.07	220	JON
1947 06 21.78		8.3	HD	14	R	16	42	2	4	0.07	245	JON
1947 06 24.78		8.7	HD	14	R	16	42	1.5	3			JON

Bright Southern Comet (1947 XII = 1947n)

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1947 12 11.42				0.0	E		1			10		JON
1947 12 11.42				14	R	16	42			1.33	125	JON
1947 12 11.42				7.8	R	4	13			3		JON
1947 12 13.44				14	R	16	42			0.67	125	JON
1947 12 13.44	S	2.9	Y	5.0	B		2					JON
1947 12 19.44	S	5 :		5.0	B		2					JON
1947 12 19.44				7.8	R	4	13			2	102	JON
1947 12 24.42				20	L	8	36	& 2.5	5	0.47		JON
1947 12 24.42	S	6.5	S	7.8	R	4	13			0.83	95	JON
1947 12 27.41	S	7.9:	V	20	L	8	36		4	0.13	90	JON
1947 12 29.41	S	8.0	V	20	L	8	36	3	5	0.17	105	JON
1947 12 30.42	S	8.3	V	20	L	8	36	3	5	0.33	100	JON
1948 01 02.43	S	8.6	V	20	L	8	36	3	4	0.12	95	JON
1948 01 03.42	S	8.9	V	20	L	8	36	2.5	4	0.17	112	JON
1948 01 05.42	S	9.3	V	20	L	8	36	2	3			JON
1948 01 06.42	S	9.0	V	20	L	8	36			0.04	90	JON

Comet Bester (1948 I = 1947k)

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1947 10 05.53	S	11.0	V	14	R	16	42	1.5	4			JON
1947 10 06.50	S	11.0	V	14	R	16	42	1.5	3			JON
1947 10 13.44	S	10.9	V	14	R	16	42	2	3			JON
1947 10 14.48	S	10.7	V	14	R	16	42	2	4		350	JON
1947 10 15.41	S	10.6	V	14	R	16	42	1.5	4			JON
1947 10 21.42	S	10.3	V	14	R	16	42	2		0.07	360	JON
1947 10 21.68	S	10.3	V	14	R	16	42		5	0.07	340	JON
1947 10 22.37	S	10.2	V	14	R	16	42			?		JON
1947 10 22.68	S	10.3	V	14	R	16	42	2	5	0.10	345	JON
1947 10 23.41	S	10.2	V	14	R	16	42	2.5		?		JON
1947 10 23.64	S	10.2	V	14	R	16	42	2.5		0.10		JON
1947 10 24.66	S	10.0	V	14	R	16	42	2	7	0.10	360	JON
1947 10 24.66	M	9.9	V	14	R	16	42					JON
1947 10 31.38	S	10.0	V	14	R	16	42	2	7			JON
1947 11 01.44	M	9.9	V	14	R	16	42					JON
1947 11 01.44	S	10.0	V	14	R	16	42	2.5	7	0.09	360	JON
1947 11 02.42	S	9.7	V	14	R	16	42		7	0.13		JON
1947 11 03.44	S	9.9	V	14	R	16	42	4		0.17		JON
1947 11 03.44	M	9.7	V	14	R	16	42					JON
1947 11 04.44	S	10.2	V	14	R	16	42				5	JON
1947 11 05.42	S	10.1	V	14	R	16	42	2.75		0.07	8	JON
1947 11 07.42	S	9.5	V	14	R	16	42					JON
1947 11 15.49	S	9.6	V	12.7	L	15	36	2		0.13	50	JON

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This index follows the style used in the previous index for Volume 4 (see ICQ 5, 13). Indices for each volume are published in the January issue of the following volume. References listed below indicate page number. For example, (39) indicates page 39, which was in Vol. 5, No. 2 (ascertained from the listing at the top of this page). --D.W.E.G.

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[Here, the following abbreviations are used for the ICQ Staff:
DWEG = D. W. E. Green; CSM = C. S. Morris; BGM = B. G. Marsden]

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NEW REPORT FORM FOR PHOTOMETRIC OBSERVATIONS OF COMETS

On the following page is an updated version of the ICQ report form published on page 47 of the April 1983 issue. The only difference is that the address for C. S. Morris has been deleted from the top of the form. As explained elsewhere in this issue, all observers should list observations of comets on this form and send to the Editor (address on page 2 of this issue) for publication in the ICQ. The headings on the report form are placed in the same order as are the observations published in the ICQ (see TABULATION OF COMET OBSERVATIONS elsewhere in this issue for more information). We again stress that the following data must be reported with each observation of a comet's brightness to make the observation eligible for publication: (1) magnitude method (M. M.); (2) total visual magnitude, estimate to tenths; (3) the stellar catalog/reference used for magnitudes of comparison stars; and (4) the complete specifications of the instrument used for the magnitude estimate, including aperture in centimeters, type (binoculars, reflector, refractor, etc.), f-ratio, and magnification. Observers are also asked to convert coma diameters to arc minutes and tail lengths to hundredths of a degree (most short tail lengths are measured in arc minutes, but the ICQ publishes length in degrees only for consistency).

COMET OBSERVING REPORT FORM. Send completed sheets to INTERNATIONAL COMET QUARTERLY, c/o D. W. E. Green; Smithsonian Astrophysical Observatory; 60 Garden Street; Cambridge, MA 02138, U.S.A. Please convert observing times to decimals of a day in Universal Time (e.g., Aug. 3, 18:00 UT = Aug. 3.75 UT). *Photocopy this sheet for more copies. (This form supercedes all previous forms. 1984 February 1.)*

PLEASE PRINT OR TYPE ONLY.

Name and designation of comet: COMET ______________________ 19_____.

Observer ______________________ Address ______________________

NOTE: *Drawings and additional comments or remarks should be included on separate sheets of paper. To be elibible for publication in the ICQ, columns below marked with an asterisk (*) must be filled in.*

Date (U.T.)*	M.* M.	Total* Magn.	Ref.*	Instr.* Aperture	Instr.* Type	f/*	Power*	Coma Dia.(')	D. C.	Tail Length(°)	P. A.	Remarks

Comet Bester (1948 I = 1947k) Cont.

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1947 11 16.39	S	9.9	V	14	R	16	42	& 2.25		0.13		JON
1947 11 19.40	S	10.1	V	14	R	16	42					JON
1947 11 19.60	S	9.6	V	14	R	16	42	& 3.25		0.13		JON
1947 11 21.60	S	9.5	V	14	R	16	42	3	6	0.13	60	JON
1947 11 29.42	S	9.7	V	14	R	16	42		7	?		JON
1947 12 03.49	S	8.9	V	14	R	16	42	5	6	0.13	78	JON
1947 12 11.50	S	8.7	V	14	R	16	42	5		0.13	83	JON
1947 12 13.54	S	8.6	V	14	R	16	42	5	4	0.13		JON
1947 12 19.52	S	8.4	V	12.7	L	15	36			?		JON
1947 12 27.47	S	8.0	V	20	L	8	35	2.5	3			JON
1947 12 29.44	S	8.2	V	20	L	8	35	3	3	&0.21		JON
1947 12 30.46	S	8.0	V	20	L	8	35	5	5	0.33		JON
1948 01 01.44	S	7.8	V	20	L	8	35	5	5	0.28	97	JON
1948 01 02.46	S	8.0	V	20	L	8	35	4	6	0.13	100	JON
1948 01 03.47	S	8.0	V	20	L	8	35	4	6	0.25	100	JON
1948 01 05.44	S	8.0	V	20	L	8	35	4	6	0.17	110	JON
1948 01 06.44	S	8.0	V	20	L	8	35	4	5/	0.17	95	JON
1948 01 11.44	S	8.0	V	14	R	16	42	4	5	0.25		JON
1948 01 12.44	S	7.8	V	14	R	16	42	2.5	5	0.10	100	JON
1948 03 06.71	S	8.0	HD	14	R	16	42		5			JON
1948 03 08.72	S	6.9	HD	14	R	16	42	2.5	5	?	270	JON
1948 03 09.72	S	7.1	A	14	R	16	42	3	5			JON
1948 03 12.71	S	6.6	A	7.8	R	8	30					JON
1948 03 12.71				20	L	8	35	5	5			JON
1948 03 13.71	S	6.3	A	7.8	R	8	30					JON
1948 03 13.71				20	L	8	35	5	5		240	JON
1948 03 14.71	S	6.5	A	14	R	16	42	4.5	4		195	JON
1948 03 17.72				31.7	L	5	62		5			JON
1948 03 17.72	S	6.3	A	2.8	R	10	15					JON
1948 03 20.72	S	6.6	A	7.8	R	8	30					JON
1948 03 20.72				20	L	8	35			0.03	230	JON

Eclipse Comet (1948 XI = 1948l)

DATE (UT)		MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1948 11 14.65	*				14	R	16	42	4	7			JON
1948 11 14.65	*	S	3.9	AT	5.0	B		2			3		JON
1948 11 14.65					0.0	E		1			5		JON
1948 11 17.66	*	S	3.8	AT	5.0	B		2			3		JON
1948 11 18.63					7.8	R	8	30			1.75		JON
1948 11 18.63	*	S	3.5	AT	5.0	B		2			3		JON
1948 11 18.63	*				14	R	16	42	3		0.83	272	JON
1948 11 25.61	*	S	4.3	AT	5.0	B		2			4		JON
1948 11 25.61					7.8	R	8	30			3		JON
1948 11 26.52	*				5.0	B		2			5	275	JON
1948 11 28.62	*	S	4.7	S	5.0	B		2			5	290	JON
1948 11 28.62					31.7	L	5	62	5.5	1	8	270	JON
1948 12 01.61	*	S	5.0	S	5.0	B		2			6	270	JON
1948 12 01.61					14	R	16	42	7	1			JON
1948 12 02.61	*	S	5.2	Y	5.0	B		2					JON
1948 12 02.61	*				14	R	16	42	8		>2	270	JON
1948 12 07.63	*	S	5.7	V	5.0	B		2			1	290	JON
1948 12 07.63	*				31.7	L	5	104	5	3			JON
1948 12 09.62	*	S	5.6	Y	5.0	B		2					JON
1948 12 09.62	*				7.8	R	4	13			1	295	JON

Eclipse Comet (1948 XI = 1948l) Cont.

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1948 12 09.62				31.7	L	5	104	5	3			JON
1948 12 10.62	*			20	L	8	35	7.5	5			JON
1948 12 10.62	*			7.8	R	4	13			1.50	305	JON
1948 12 10.62	* S	5.5	Y	5.0	B		2			2		JON
1948 12 11.55	* S	5.6	Y	5.0	B		2					JON
1948 12 11.55	*			31.7	L	5	104	4	4	?	305	JON
1948 12 15.61	* S	5.8	Y	5.0	B		2					JON
1948 12 15.61	*			31.7	L	5	104	4	4			JON
1948 12 17.42	* S	5.9	Y	5.0	B		2					JON
1948 12 20.5	* S	6.1	Y	5.0	B		2					JON
1948 12 20.5	*			14	R	16	42	5	5	0.08	330	JON
1948 12 21.5	* S	6.2	Y	5.0	B		2					JON
1948 12 21.5				14	R	16	42	6	5	?		JON
1948 12 24.52	* S	7.0	Y	7.8	R	4	13					JON
1948 12 24.52				20	L	8	35	4	4	0.13	330	JON
1948 12 28.52	* S	7.3	V	7.8	R	4	13					JON
1948 12 28.52	*			20	L	8	35	& 4.5	4	&0.08	360	JON

Comet Wirtanen (1949 I = 1948h)

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1949 04 29.72	S	13.3	V	31.7	L	5	104	0.67	3			JON

Comet Minkowski (1951 I = 1950b)

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1950 07 05.46	* S	10.9	V	31.7	L	5	62		6		100	JON
1950 07 16.45	* S	11.7	V	31.7	L	5	104	0.5	4			JON
1950 07 18.39	* S	11.3	V	31.7	L	5	104	0.75			100	JON
1950 07 18.39	S	11.7	V	14	R	16	42					JON
1950 07 19.39	* S	11.5	V	31.7	L	5	104	0.75	4		90	JON
1950 08 03.34	* S	11.8	V	31.7	L	5	62	1	5	?	95	JON
1950 08 10.34	* S	12.4	V	31.7	L	5	62	0.75	7	?		JON
1950 08 13.34	* S	12.2	V	31.7	L	5	62	0.75	5	?	95	JON
1950 09 02.38	* S	11.5	A	20	L	8	35					JON
1951 01 05.75	* S	10.8	V	20	L	8	35					JON
1951 01 07.62	* S	10.8	V	20	L	8	35	1	6	?	50	JON
1951 01 14.60	* S	11.0	V	31.7	L	5	52	1	5	0.05	35	JON
1951 01 19.62	* S	10.4	V	31.7	L	5	52					JON
1951 01 19.62	* S	10.8	V	14	R	16	42					JON
1951 02 13.62	* S	10.5	V	31.7	L	5	52					JON
1951 02 13.62	* S	10.4	V	14	R	16	42	1.25	8			JON
1951 02 16.64	* S	10.1	V	20	L	8	35	1.25	7			JON
1951 03 07.46	* S	9.9	V	31.7	L	5	48					JON
1951 03 07.46	*			14	R	16	42	2.25	7	?	20	JON
1951 03 12.46	* S	9.9	V	14	R	16	42	2	8	0.08	50	JON
1951 03 15.46	* S	9.8	V	14	R	16	42	2		0.10	70	JON
1951 03 15.46	* S	9.9	V	31.7	L	5	48					JON
1951 03 15.46	* S	9.6	V	7.8	R		30					JON
1951 03 16.60	* S	9.9	V	14	R	16	42					JON
1951 03 17.60	* S	10.2	V	14	R	16	42	2.25	8	0.06	18	JON
1951 03 17.60	* S	10.0	V	31.7	L	5	48					JON
1951 03 18.69	* S	10.2	V	31.7	L	5	48		8		65	JON
1951 04 05.43	* S	10.2	V	31.7	L	5	48					JON
1951 04 05.43	* S	10.2	V	14	R	16	42	1.5	8			JON

Comet Minkowski (1951 I = 1950b) Cont.

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1951 04 06.46	* S	10.2	V	20	L	8	35	1.5	8	?	70	JON
1951 04 08.44	* S	10.2	V	31.7	L	5	48		8	0.13	90	JON
1951 05 02.42	* S	11.0	V	31.7	L	5	48				80	JON
1951 05 02.42	*			14	R	16	42	0.75	5			JON
1951 05 03.42	* S	11.2	V	14	R	16	42					JON
1951 05 03.42	* S	10.9	V	31.7	L	5	48		6	0.05	85	JON
1951 05 05.37	* S	11.4	V	14	R	16	42	0.67	6			JON
1951 05 05.37	* S	11.4	V	31.7	L	5	48		6		110	JON
1951 05 06.33	* S	11.1	V	31.7	L	5	48				80	JON
1951 05 07.42	* S	11.2	V	31.7	L	5	48		5			JON
1951 05 27.33	* S	12.2	V	31.7	L	5	48					JON
1951 05 27.33	* S	12.6	V	14	R	16	42	0.5	2			JON
1951 06 09.29	* S	12.8	V	31.7	L	5	48					JON
1951 06 30.29	* S	12.6	V	31.7	L	5	48	0.75	2			JON

Comet Wilson-Harrington (1952 I = 1951i)

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1951 12 27.62	* S	9.7	V	20	L	8	35	1	4	0.04	270	JON
1951 12 28.62	* S	9.5	V	20	L	8	58	0.75	4	0.03	270	JON
1951 12 30.60	* S	8.9	V	7.5	R	12	23					JON
1951 12 31.61	S	8.4	V	7.5	R	12	23					JON
1951 12 31.61	* S	8.5	V	20	L	8	58	1.25	5	0.12	250	JON
1952 01 02.61	* S	8.6	V	20	L	8	58	1	8	0.17	266	JON
1952 01 02.61	S	8.4	V	7.5	R	12	23					JON
1952 01 05.61	* S	8.4	V	7.5	R	12	23					JON
1952 01 05.61	* S	8.7	V	20	L	8	58	1.25	8	0.20	270	JON
1952 01 06.62	S	8.5	V	20	L	8	58					JON
1952 01 06.62	* S	8.4	V	20	L	8	35	1.25	8	0.20	264	JON
1952 01 06.62	S	8.2	V	7.5	R	12	23					JON
1952 01 13.63	* S	7.7	V	7.8	R	8	30					JON
1952 01 13.63	*			31.7	L	5	86	0.75	5	0.25	260	JON
1952 01 18.63	* S	7.1	V	7.8	R	8	30			1	245	JON
1952 01 21.55	*			31.7	L	5	86		8			JON
1952 01 21.55	* S	7.1	V	7.8	R	8	30			0.75	250	JON
1952 01 23.66	* S	7.1	V	7.8	R	8	30			0.75	245	JON
1952 01 23.66				31.7	L	5	86	2	6			JON
1952 01 23.66	S	7.0	V	5.0	R							JON
1952 01 26.48	*			20	L	8	96	3	8			JON
1952 01 26.48	* S	6.4	V	7.5	R	12	23			0.75	215	JON
1952 01 28.66	* S	6.3	V	5.0	R		7			1	180	JON
1952 01 28.66	*			31.7	L	5	86	3	8			JON
1952 02 05.44	* S	7.1	V	5.0	R		7					JON
1952 02 05.44	*			7.5	R	12	23			0.75		JON
1952 02 05.44	*			31.7	L	5	86	3				JON
1952 02 13.42	* S	8.2	V	7.8	R	8	30		6	0.12	90	JON
1952 02 15.40	*	8.8	V	7.5	R	12	23		6			JON
1952 02 23.40	* S	9.3	V	20	L	8	54	1	5	0.33	80	JON
1952 02 24.39	* S	10.2	V	31.7	L	5	48		5	0.33		JON

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UNIVERSAL TIME (UT): This time based on the Greenwich meridian is used throughout the ICQ; it is 24-hour time, from midnight to midnight. In North America, add the following numbers to standard times to convert to UT: EST, 5; CST, 6; MST, 7; PST, 8. For daylight savings time, add 4, 5, 6, and 7 hours, respectively.

Comet Mrkos (1952 V = 1952c)

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1952 06 25.76	* S	9.7	A	14	R	16	34	3	2			JON
1952 06 26.76	* S	9.7	A	7.8	R	8	30					JON
1952 06 26.76	S	9.7	A	31.7	L	5	48					JON
1952 06 29.76	* S	9.4	A	14	R	16	34	4	3			JON
1952 06 29.76				31.7	L	5	86	3	2			JON
1952 07 03.75	* S	9.0	A	7.8	R	8	30	6				JON
1952 07 03.75				31.7	L	5	86	3	4			JON
1952 07 15.49				31.7	L	5	86	3	4			JON
1952 07 15.49	* S	8.9	A	7.8	R	8	30					JON
1952 07 16.48	* S	8.7	A	7.8	R	8	30					JON
1952 07 16.48				31.7	L	5	86		5			JON
1952 07 21.48	* S	8.9	V	7.8	R	8	30	5				JON
1952 07 23.48	* S	8.6	V	7.8	R	8	30		4			JON
1952 07 24.49				31.7	L	5	86	3.5	6			JON
1952 07 24.49	* S	8.6	V	7.8	R	8	30	6.5				JON
1952 07 25.46	* S	9.1	V	7.8	R	8	30	5				JON
1952 07 25.46				31.7	L	5	86	3	5			JON
1952 07 27.47	* S	9.3	V	31.7	L	5	48	3.5	5/			JON
1952 07 27.47	* S	9.1	V	7.8	R	8	30	6				JON
1952 07 28.72	S	9.0	V	7.8	R	8	30					JON
1952 07 30.71	* S	9.7	V	31.7	L	5	48	2.75	2			JON
1952 07 30.71	* S	10.3	V	31.7	L	5	86					JON
1952 08 01.72	* S	11.5	V	31.7	L	5	48	1.5	1			JON

Comet Harrington (1953 I = 1952e)

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1952 12 12.44	* S	9.0	V	7.5	R	12	23					JON
1952 12 12.44				20	L	8	35	3.5	4			JON
1952 12 17.45	* S	9.2	V	7.8	R	8	30					JON
1952 12 17.45				31.7	L	5	86	3	4			JON
1953 01 08.45	* S	9.0	V	7.5	R	12	23					JON
1953 01 10.46	* S	9.4	V	7.5	R	12	23					JON
1953 01 18.46	* S	9.8	V	7.8	R	8	30					JON
1953 01 18.46				31.7	L	5	86	2.5	4			JON
1953 01 20.45	* S	9.8	V	7.8	R	8	30					JON
1953 02 08.42	S			31.7	L	5	48	3.5	5			JON
1953 02 21.40	* S	8.8	V	7.5	R	12	23	3	3			JON
1953 02 22.40	* S	8.6	V	7.0	R	10	21					JON
1953 02 22.40				31.7	L	5	48	3	4			JON
1953 03 07.41				20	L	8	54	2.25	4			JON
1953 03 07.41	* S	10.1	V	7.5	R	12	23					JON
1953 03 10.39				31.7	L	5	48	3	4			JON
1953 03 12.40				31.7	L	5	48	2.5	5			JON
1953 03 18.39				31.7	L	5	48	2.5	4			JON
1953 03 20.38	* S	9.9	V	7.5	R	12	23					JON
1953 03 20.38				20	L	8	54	2.5	3			JON
1953 03 21.42	* S	10.1	V	7.5	R	12	23					JON
1953 03 21.42				20	L	8	96		4			JON
1953 04 05.37	* S	9.9	V	7.5	R	12	23					JON
1953 04 05.37				20	L	8	54	2.5	3			JON
1953 04 10.35	* S	9.8	V	7.0	R	10	21					JON
1953 04 10.35				31.7	L	5	48	2.5	4			JON

Comet Harrington (1953 I = 1952e) Cont.

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1953 04 14.35				31.7	L	5	48	2	3			JON
1953 04 14.35	S	10.1	V	7.0	R	10	21					JON
1953 04 16.36	* S	10.5	V	14	R	16	34					JON
1953 04 16.36				31.7	L	5	86		2			JON
1953 05 06.34	S	12.0	V	14	R	16	34					JON
1953 05 06.34	S	12.0	V	31.7	L	5	48	< 1				JON
1953 05 07.31	* S	11.5	V	14	R	16	34					JON

Mrkos (1953 II = 1952f)

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1952 12 23.58	* S	8.6	V	7.5	R	12	23					JON
1952 12 23.58				20	L	8	35	2.5	6			JON
1952 12 24.59	* S	8.4	V	7.5	R	12	23					JON
1952 12 24.59				20	L	8	35	4	7			JON
1952 12 25.60	* S	8.3	V	7.5	R	12	23					JON
1952 12 25.60				20	L	8	35	3	7		240	JON
1952 12 26.61	* S	8.2	V	7.5	R	12	23					JON
1952 12 26.61				20	L	8	35	3	7			JON
1952 12 28.62	* S	8.4	V	7.5	R	12	23					JON
1952 12 28.62				20	L	8	35	2				JON
1952 12 29.63	* S	8.2	V	7.5	R	12	23					JON
1952 12 29.63				20	L	8	54	2.5	6			JON
1953 01 06.48				20	L	8	54		6			JON
1953 01 06.48	* S	8.2	V	7.5	R	12	23					JON
1953 01 07.46	* S	8.3	V	7.5	R	12	23					JON
1953 01 07.46				20	L	8	35	3.5	6			JON
1953 01 08.48	* S	8.3	V	7.5	R	12	23					JON
1953 01 08.48				20	L	8	96		7			JON
1953 01 10.53	* S	8.1	V	7.5	R	12	23					JON
1953 01 10.53				20	L	8	54	4	7		270	JON
1953 01 13.64				31.7	L	5	48	3	7			JON
1953 01 13.64	* S	7.9	V	7.8	R	8	30					JON
1953 01 20.51	S	8.2	V	5.0	R		7					JON
1953 01 20.51	* S	8.1	V	7.8	R	8	30					JON
1953 01 27.63	* S	8.2	V	7.8	R	8	30					JON
1953 02 06.41	* S	8.0	V	7.8	R	8	30					JON
1953 02 09.42	* S	8.2	V	7.8	R	8	30		6			JON

Comet Abell (1954 X = 1953g)

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1954 06 28.29	S	7.5	HR	5.0	R		7					JON
1954 06 28.29				31.7	L	5	48	2.5	6	0.03	130	JON
1954 07 01.29	*			31.7	L	5	48	2	6	?	120	JON
1954 07 02.29				31.7	L	5	48	2.5	7	?	165	JON
1954 07 06.28	* S	6.9	HR	7.8	R	8	30					JON
1954 07 23.31				31.7	L	5	48	3	6	0.07	125	JON
1954 07 24.30	* S	6.5	HR	5.0	R		7					JON
1954 07 24.30				7.8	R	8	30			0.25	110	JON
1954 07 27.31	*			31.7	L	5	48	3.5	7	0.42	130	JON
1954 08 09.33	* S	8.5	HD	7.8	R	8	30					JON
1954 08 09.33				31.7	L	5	48	4	6	?		JON

Comet Abell (1954 X = 1953g) Cont.

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1954 08 18.33				31.7	L	5	48	2.5	6	0.08	100	JON
1954 08 21.35	* S	8.9	HD	7.8	R	8	30					JON
1954 08 21.35				31.7	L	5	48			0.07	140	JON
1954 08 25.35	* S	7.9	V	7.8	R	8	30					JON
1954 08 25.35				31.7	L	5	48	3		0.20	100	JON
1954 08 29.34				31.7	L	5	48	3	6		125	JON
1954 08 29.34	* S	7.8	V	7.8	R	8	30					JON
1954 09 07.70	* S	9.9	HD	7.8	R	8	30					JON
1954 09 07.70				31.7	L	5	86		4			JON
1954 09 24.38	* S	10.4	V	7.5	R	12	18					JON
1954 09 24.38				20	L	8	35	3				JON
1954 10 01.39	S	10.6	V	31.7	L	5	48		3			JON
1954 10 15.44	* S	11.7	V	20	L	8	35	2	1			JON
1954 10 24.48	* S	11.8	V	20	L	8	35	1	3			JON

Comet West (1976 VI = 1975n)

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1976 03 04.20				6.0	R	13	16	0.3		0.8		ANT
1976 03 12.19				11.0	R	13	27	0.3		1		ANT
1976 03 12.19	S	3.3	SP	3.0	B	4	6			2		ANT
1976 03 18.18	S	3.8	SP	3.0	B	4	6			1		ANT
1976 03 19.18	S	3.9	SP	3.0	B	4	6					ANT
1976 03 25.15	S	4.6	SP	3.0	B	4	6			1		ANT
1976 03 29.16	S	5.4	SP	3.0	B	4	6			0.5		ANT
1976 04 01.15	S	5.8	SP	3.0	B	4	6			0.3		ANT
1976 04 04.14	S	5.9	SP	3.0	B	4	6					ANT
1976 04 11.20	S	6.6	SP	3.0	B	4	6			0.4		ANT

Comet IRAS-Araki-Alcock (1983d)

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1983 05 07.19	S	4.8	A	5.0	R	6	20	105	4			LYN
1983 05 09.08	S	4.5	SC	10.5	B		30	120	4			LYN

Comet Černis (1983l)

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1983 09 27.59	S	9.3	AC	15.2	L	5	30	4	5	&0.2		PEA
1983 10 01.65	S	9.4	AC	15.2	L	5	30	4	7	0.25	0	PEA
1983 10 01.65	S	9.8	AC	41	L	4	86	3.5	8	0.25	0	CLA
1983 10 01.66	S	9.5	AC	20	L	7	35		7/	0.25	0	PEA
1983 10 02.60	S	9.4	AC	20	L	7	70	4	8	0.55	0	PEA
1983 10 02.61	S	9.3	AC	15.2	L	5	30	4.5	8	0.5	0	PEA
1983 10 02.74	S	9.6	AC	41	L	4	86	4	8	0.75	0	CLA
1983 10 04.73	S	9.2	AC	15.2	L	5	30	4	7	0.6	5	PEA
1983 10 05.74	S	9.1	AC	15.2	L	5	30	4.5	7	0.5	7	PEA
1983 10 05.74	S	9.0	AC	6.5	B		20	5	6/	0.25	5	PEA
1983 10 08.73	S	9.2	AC	15.2	L	5	30	4	7	0.42	5	PEA
1983 10 09.74	S	9.2	AC	15.2	L	5	30	4	7	0.45	7	PEA
1983 10 11.73	S	9.2	AC	15.2	L	5	30	4.2	6	0.5	5	PEA
1983 10 12.75	S	9.6	AC	41	L	4	86	4	8	0.42	358	CLA
1983 10 14.78	S	9.3	AC	15.2	L	5	30	4	7	0.3	10	PEA
1983 10 15.84	S	9.4	AC	15.2	L	5	30	4	7	0.25	20	PEA
1983 10 27.55	S	9.8	AA	41	L	4	86	4	7	0.50	338	CLA

Comet Černis (1983l) Cont.

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1983 10 27.64	S	9.6	AA	15.2	L	5	30	4	7	0.13	12	PEA
1983 10 28.68	S	9.5	AA	15.2	L	5	30	4.2	6/	0.17	15	PEA
1983 10 29.67	S	9.6	AA	15.2	L	5	30	3.8	6	0.4	10	PEA
1983 10 30.60	S	9.7	AA	15.2	L	5	30	3.5	6	0.2	16	PEA
1983 10 31.68	S	9.7	AA	15.2	L	5	30	3.5	6	0.17	15	PEA
1983 11 01.69	S	9.7	AA	15.2	L	5	30	3.75	6/			PEA
1983 11 01.69	M	9.8	AA	15.2	L	5	30					PEA
1983 11 04.59	S	9.8	AA	15.2	L	5	30	3.5	7			PEA
1983 11 05.59	S	10.0	AA	41	L	4	86	3.5	7	0.33	320	CLA
1983 11 05.61	S	9.8	AA	15.2	L	5	30	2.8	6/	?	10	PEA
1983 11 08.60	S	10.2	AA	41	L	4	86	3	6	0.25		CLA
1983 11 08.64	S	10.0	AA	15.2	L	5	30	2.75	5			PEA
1983 11 09.60	S	9.9	AA	15.2	L	5	30	4.2	5			PEA
1983 11 09.64	S	9.9	AA	15.2	L	5	30	4	5			PEA
1983 11 10.65	S	9.9	AA	15.2	L	5	30	3.5	5			PEA
1983 11 22.56	S	10.3	AA	15.2	L	5	30	2	5			PEA
1983 11 23.59	S	10.4	AA	15.2	L	5	30	1.75	4/			PEA
1983 11 24.59	S	10.4	AA	15.2	L	5	30	1.8	4			PEA
1983 11 25.58	S	10.5	AA	15.2	L	5	30	2	4			PEA
1983 11 26.55	S	10.4	AA	15.2	L	5	30	2.5	3			PEA
1983 11 26.57	S	10.7	V	41	L	4	86	2.25	6	0.10	290	CLA
1983 11 27.55	S	10.4	AA	15.2	L	5	30	2.8	4/			PEA
1983 11 29.56	S	10.5	AA	15.2	L	5	30	2.5	4			PEA
1983 12 02.54	S	10.6	AA	15.2	L	5	30	2.5	3			PEA
1983 12 07.60	S	11.1	V	41	L	4	86	2	6			CLA
1983 12 10.66	S	11.4	V	41	L	4	86	& 1.75	6			CLA

Comet Shoemaker (1983p)

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1983 09 27.58	S	10.8	AC	15.2	L	5	72	1.0	3			PEA
1983 10 01.67	S	11.3	AC	41	L	4	86	1.25	4			CLA
1983 10 01.68	S	10.9	AC	15.2	L	5	30	1.2	5			PEA
1983 10 04.72	S	11.0	AC	15.2	L	5	30	1.2	5/			PEA
1983 10 05.72	S	11.0	AC	15.2	L	5	30	1.0	5			PEA
1983 10 10.55	S	11.7:	AC	41	L	4	86	1.5	4			CLA
1983 10 12.73	S	11.9	VN	41	L	4	86	1.25	3			CLA
1983 10 27.57	S	11.8	VN	41	L	4	86		2			CLA
1983 11 05.61	S	12.2	VN	41	L	4	86	1.5	1			CLA
1983 11 08.59	S	12.4	VN	41	L	4	86	1.25	2			CLA
1983 11 26.56	S	12.8	VN	41	L	4	86	1	1			CLA

Periodic comet Encke (1951 III = 1954 IX)

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1951 04 05.68	S	10.0	V	14	R	16	42					JON
1951 04 05.75	S	9.1	V	14	R	16	42	3.5	4			JON
1951 04 07.68	S	9.5	V	7.5	R	12	23					JON
1951 04 14.71	S	10.8	V	14	R	16	42	3	2			JON
1951 04 14.75	S	11.0	V	31.7	L	5	48					JON
1951 04 19.75	S	12 :	V	31.7	L	5	48					JON
1954 07 22.29	* S	9.6	V	7.8	R	8	30					JON
1954 07 23.29	* S	9.6	V	7.8	R	8	30					JON
1954 07 27.30	* S	9.8	V	7.8	R	8	30					JON

Periodic Comet Grigg-Skjellerup (1947 II = 1952 IV)

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1947 04 29.74	S	9.5	A	14	R	16	42	3	2			JON
1947 04 30.73	S	9.5	A	14	R	16	42	2.5	2			JON
1952 03 25.71	S	12.5	V	31.7	L	5	86	3	4		80	JON
1952 03 28.70	S	11.7	V	14	R	16	34					JON
1952 03 28.70	S	12.2	V	31.7	L	5	86		3			JON
1952 04 03.73	S	12.1	V	31.7	L	5	86		3			JON
1952 04 06.72	S	12.0	V	31.7	L	5	48					JON
1952 04 06.72	S	12.1	V	31.7	L	5	86	1.5				JON
1952 04 07.74	S	12.4	V	31.7	L	5	48	1.5	1			JON

Periodic Comet Tempel 1 (1982j)

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1983 05 07.23	S	10.0	A	44	L	4	150	1.75	2/			LYN
1983 09 25.51	S	12.5	AC	41	L	4	86	1.5	0			CLA
1983 10 01.54	S	12.8	AC	41	L	4	86	1.5	0			CLA

Periodic Comet Tempel 2 (1982d)

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1983 10 01.68	S	11.1	AC	41	L	4	86	3	0			CLA
1983 10 01.70	S	10.9	AC	15.2	L	5	30	3	0			PEA
1983 10 12.78	S	11.2	AC	41	L	4	86	3	1			CLA
1983 10 27.59	S	11.4	AC	41	L	4	86	4	1			CLA
1983 11 08.61	S	11.6	V	41	L	4	86	3	1			CLA

Periodic Comet d'Arrest (1950 II = 1950a)

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1950 07 17.76	S	11.5	V	31.7	L	5	104	2	1			JON
1950 07 18.77	S	11.6	V	31.7	L	5	104	2	1			JON
1950 07 19.76	S	11.6	V	31.7	L	5	104	2	1			JON
1950 07 20.76	S	11.6	V	31.7	L	5	104	2	1			JON
1950 08 10.72	S	11.8	V	31.7	L	5	62	& 1.75	2			JON
1950 08 11.72	S	11.9	V	31.7	L	5	62	& 1.75	1			JON
1950 08 12.74	S	11.6	V	31.7	L	5	62	& 1.75	1			JON
1950 08 13.72	S	12.0	V	31.7	L	5	62		1			JON
1950 08 14.73	S	11.9	V	31.7	L	5	62	2	2			JON
1950 08 15.73	S	12.0	V	31.7	L	5	62	1.5	2			JON
1950 08 18.71	S	11.9	V	31.7	L	5	104	& 2				JON
1950 09 09.70	S	12.0	V	31.7	L	5	62		4			JON
1950 09 11.67	S	11.8	V	31.7	L	5	62	2	3			JON

Periodic Comet Kopff (1982k)

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1983 05 07.26	S	11.0	A	20	R	11	52	2	5			LYN
1983 05 08.12	S	10.8	SC	10.5	B		30	2	6			LYN
1983 05 18.08	S	10.5	A	20	R	11	52	1	3/			LYN
1983 07 01.11	S	9.5	A	11	L	6	40	7	7			LYN
1983 07 04.12	S	9.7	A	11	L	6	40	7	7			LYN
1983 07 05.12	S	9.7	A	11	L	6	40	5	7			LYN
1983 09 27.58	S	10.8	AA	15.2	L	5	72	1.8	2			PEA
1983 10 01.51	S	11.2	VN	15.2	L	5	30	2.5	1			PEA
1983 10 02.50	S	11.1	VN	20	L	7	70	3	5			PEA

Periodic Comet Kopff (1982k) Cont.

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1983 10 02.50	S	11.0	VN	15.2	L	5	30	3	4			PEA
1983 10 02.54	S	11.5	VN	41	L	4	86	3	6			CLA
1983 10 04.52	S	11.1	VN	15.2	L	5	30	2.8	4			PEA
1983 10 05.50	S	11.1	VN	15.2	L	5	30	3.2	4			PEA
1983 10 09.51	S	10.5	VN	15.2	L	5	30	2.3	1			PEA
1983 10 10.58	S	11.5	VN	41	L	4	86	3	3			CLA
1983 10 27.57	S	11.3	VN	41	L	4	86	3	0			CLA
1983 11 02.52	S	11.6	VN	41	L	4	86	4	2			CLA
1983 11 08.56	S	12.0:	VN	41	L	4	86	2	1			CLA

Periodic Comet Giacobini-Zinner (1946 V = 1946c)

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1946 10 02.70	S	9 :		14	R	16	42					JON
1946 10 03.62	S	9 :		14	R	16	42			0.07	260	JON
1946 10 07.66				14	R	16	42			0.10	270	JON
1946 10 24.64	S	10.5	V	14	R	16	42			0.05	270	JON
1946 10 31.67				14	R	16	42			?		JON

Periodic Comet Ashbrook-Jackson (1948 IX = 1948i)

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1948 09 10.44	S	12.0	V	31.7	L	5	62	0.75	3	0.03	272	JON
1948 09 10.64	S	12.3	V	31.7	L	5	62	& 1	3		272	JON
1948 09 12.68	S	12.5	V	31.7	L	5	62	0.67				JON
1948 09 20.34	S	12.0	V	31.7	L	5	62	1.25		?		JON
1948 09 21.39	S	12.3	V	31.7	L	5	62	1.25		?		JON
1948 09 24.52	S	12.3	V	31.7	L	5	62	1.25	3			JON
1948 09 25.49	S	12.0	V	31.7	L	5	62	1.25	4	?		JON
1948 09 28.40	S	12.0	V	31.7	L	5	62	1.25	4	0.03	270	JON
1948 10 08.40	S	12.0	V	31.7	L	5	62	1	4			JON
1948 10 21.42	S	13.0	V	31.7	L	5	62	0.67	2			JON
1948 10 25.44	S	12.6	V	31.7	L	5	62	0.5	2			JON
1948 10 27.42	S	12.9	V	31.7	L	5	62	0.67	2			JON
1948 11 03.44	S	13.2	V	31.7	L	5	104	0.5	2			JON
1948 11 04.41	S	13.4:	V	31.7	L	5	104		2			JON

Periodic Comet Pons-Brooks (1954 VII = 1953c)

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1954 06 22.28				14	R	16	42	3.5	6			JON
1954 06 22.28	S	6.4	Y	2.8	R	10	15					JON
1954 06 23.27	S	6.4	AT	2.8	R	10	15					JON
1954 06 28.27	S	6.1	Y	2.8	R	10	15					JON
1954 07 01.27	S	6.6	HR	2.8	R	10	15					JON
1954 07 02.27	*			14	R	16	42		5			JON
1954 07 02.27	S	6.8	HR	2.8	R	10	15					JON
1954 07 03.27				31.7	L	5	48	3	5			JON
1954 07 03.27	S	7.5	HR	2.8	R	10	15					JON
1954 07 07.77	S	7.3	V	7.8	R	8	30					JON
1954 07 09.77	* S	7.4	V	7.8	R	8	30					JON
1954 07 13.78	* S	8.0	V	7.8	R	8	30					JON
1954 07 23.33	* S	8.7	V	7.8	R	8	30					JON
1954 07 24.32	* S	8.4	V	7.8	R	8	30					JON
1954 07 27.34	* S	8.7	V	7.8	R	8	30					JON

Periodic Comet Pons-Brooks (1954 VII = 1953c) Cont.

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1954 07 27.77	* S	8.3	V	7.8	R	8	30					JON
1954 07 29.77	* S	8.2	V	7.8	R	8	30					JON
1954 08 07.76	* S	8.6	HD	7.8	R	8	30					JON
1954 08 09.76	* S	9.7	CP	7.8	R	8	30					JON
1954 08 09.76	*			31.7	L	5	48	2.5	2			JON
1954 08 16.33	S	10.1	V	31.7	L	5	48		1/			JON
1954 08 16.33	* S	10.0	V	7.8	R	8	30					JON
1954 08 24.33	* S	10.3	V	7.8	R	8	30					JON
1954 08 27.73	* S	10.3	V	7.8	R	8	30					JON
1954 08 29.36	* S	10.5	V	7.8	R	8	30					JON
1954 09 25.36	* S	11.6	V	20	L	8	35	2.5	0			JON

Periodic Comet Crommelin (1983n)

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1984 01 21.16	S	11.4	AC	20	L	6	61	3.1	2			MOR
1984 01 25.15	M	10.5	AC	20	L	6	61	2.5	3	?	280	MOR
1984 01 29.15	S	9.8	AC	8.0	B		20					MOR
1984 01 29.15	M	9.9	AC	20	L	6	61	2.8	5	?	280	MOR
1984 01 30.15	M	9.7	AC	20	L	6	61		4	?	280	MOR

Periodic Comet Hartley-IRAS (1983v)

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1983 12 08.98	M	10.7	AC	25	L	7	103	1.7	2			MOR
1984 01 29.11	S	10.5:	AC	20	L	6	61		3/			MOR

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RECENT NEWS CONCERNING COMETS

The last provisional letter designation of 1983 went to periodic comet Clark (P/Clark) as comet 1983w. Of the 22 comets receiving letter designations last year (comet 1983a was a photographic flaw and does not exist), 12 were new discoveries and 10 were recoveries of short-period comets observed at previous apparitions. Of the 12 new discoveries, 5 are new short-period comets. Six amateur astronomers had comets named for them in 1983, as 1 English, 1 Russian, and 4 Japanese observers independently discovered one comet each for a total of 3 comets (comets IRAS-Araki-Alcock, Sugano-Saigusa-Fujikawa, and Černis).

Three minor planets, or asteroids, discovered in the latter part of 1983 have orbits which suggest that they may have been active cometary nuclei at some times in the past: 1983 SA, 1983 TB, and 1983 XF. (See also the correction at the end of this article.)

Despite the fact that P/Crommelin was designated as the "official test run comet" of the IHW, very few astrometric observations have been made of this comet. Comet 1983n has been followed during the month of January by several visual observers, as it has begun its characteristically-rapid rise in pre-perihelion brightness. The object was extremely diffuse and between 12th and 13th total magnitude during the first part of January, but by the end of the month, it had become brighter than 10th magnitude and was becoming increasingly more condensed. An ephemeris for comet 1983n was published in the last issue of the ICQ (p. 89).

Comet 1983v has turned out to be a most interesting short-period comet with a period around 21 years. P/Hartley-IRAS has an inclination of about 96 degrees -- highly unusual for a comet with so short a period. This comet is favorably placed at this apparition for observers in the northern hemisphere. It has been around total visual magnitude 10.5, and the ephemeris below is based on the elements by Brian G. Marsden that were published on MPC 8465.

P/Honda-Mrkos-Pajdušáková is approaching a very poor apparition for earth-based viewers next year, but an ephemeris is provided below (in advance) for those who wish to try observing it.

John E. Bortle (Stormville, NY) has reported the first observation of comet P/Encke in quite some time, at total visual magnitude 11.7 at the end of January. An ephemeris for this comet is provided below, although P/Encke will not be well placed with respect to the sun.

William Bradfield of Australia has discovered his 12th comet, 1984a, placing him in a tie with M. Honda as the two living comet hunters with the most discoveries. None of Bradfield's twelve comets shares the name of any other discoverer, a feat which only a handful of comet discoverers have ever accomplished throughout history! Comet 1984a, apparently at perihelion in late December of 1983 at a distance of some 1.4 AU, was around mag 12 at discovery and is fading as it recedes from the earth and sun. Its extreme southern declination will prevent northern hemisphere visual observers from detecting this comet.

Michael Clark of New Zealand, discoverer of P/Clark, reported a discovery of another comet on plates taken with the Harvard Damon Patrol camera at Mt. John University Observatory in January. The object was designated comet 1984b, but it appears that the object was either a plate flaw or a ghost image of a nearby bright star.

M. Huruhata writes that he has been continuously observing for outbursts of P/Schwassmann-Wachmann 1 during the past year, in between consecutive solar conjunctions. He and other Japanese observers observed on almost every night around 1983 Feb. 19, and could not detect the comet (it was reported then by Merlin and Shanklin to be in outburst) at that time. They did not detect any other outbursts during their recent monitoring of this interesting object. See also Huruhata 1982, ICQ 4, 59.

D. P. Cruikshank and R. H. Brown (1983, Icarus 56, 377) recently reported P/Schwassmann-Wachmann 1 at total visual magnitude 17.6 on 5 occasions from 1983 April 13 to May 8, from observations made with the 3-m NASA Infrared Telescope at Mauna Kea in Hawaii.

Several observers, however, did report their observations of the outburst of P/Schwassmann-Wachmann 1 in late February and early March 1983. The only other reported outbursts of this comet since its brightening in 1982 April are a single observation by J.-C. Merlin in late 1983 April and a pair of observations in mid-July 1983. An extended ephemeris for this comet is provided in this issue (below) to encourage the monitoring of it for outbursts. A typical observed outburst finds the object at total visual magnitude 11.5 to 13.5, so very careful observing is necessary to confirm an outburst. Due to the strange nature of P/Schwassmann-Wachmann 1, the ICQ will continue its policy of publishing carefully-made negative observations of this object; please state an upper limit on brightness, if the comet is not found (state also the usual information; include UT date and instrumental data).

CORRECTION TO LAST ISSUE, page 88, top line of 2nd column: "some 1.3 AU" should read "some 0.14 AU". It is the semimajor axis of 1983 TB that is about 1.3 AU in extent.

-- Daniel W. E. Green, 1/31/84

EPHEMERIS FOR PERIODIC COMET HONDA-MRKOS-PAJDUSAKOVA FOR 1985

The following ephemeris is based on elements published by S. Nakano in Nakano wa Kangaeru noda (NK No. 432). The magnitudes are based on the study by D. W. E. Green (1980, J. Assn. Lunar Planet. Observers 28, 197). This is an extremely poor apparition for this comet, as its apparent elongation from the sun will be quite small, and the ephemeris is provided in the hopes that large telescope users may locate the comet in April or perhaps early July of next year. (SEE NEXT PAGE...)

Date	ET	R. A. (1950)	Decl.	Delta	r	Elong.	Mag.
1985 02	24	20 54.07	-18 46.9	2.465	1.614	24.2	14.1
1985 03	06	21 23.15	-16 49.8				
1985 03	16	21 54.97	-14 22.2	2.136	1.354	29.0	13.2
1985 03	26	22 30.16	-11 17.3				
1985 04	05	23 09.48	-07 28.4	1.833	1.078	29.3	12.2
1985 04	15	23 53.84	-02 50.2				
1985 04	25	00 44.26	+02 36.1	1.616	0.796	23.1	10.9
1985 05	05	01 41.66	+08 36.3				
1985 05	15	02 46.60	+14 36.8	1.541	0.574	10.0	9.8
1985 05	25	03 58.02	+19 43.2				
1985 06	04	05 11.61	+22 59.5	1.589	0.590	6.0	9.9
1985 06	14	06 21.52	+24 05.6				
1985 06	24	07 23.72	+23 23.8	1.740	0.826	17.2	11.2
1985 07	04	08 16.95	+21 32.9				
1985 07	14	09 01.86	+19 06.2	1.990	1.109	21.5	12.4

EPHEMERIS FOR P/WILD 2 (1983s)

Periodic comet Wild 2 should be visible in moderate-sized telescopes during the coming months. The following ephemeris is from orbital elements by S. Nakano from Minor Planet Circular (MPC) 7658, and the predicted total visual magnitudes are from J. Bortle (1978, Sky Tel. 56, 121).

T = 1984 Aug. 20.1882 ET			
Peri. = 40°.0460	1950.0	q = 1.494014 AU	
Node = 136.0399	1950.0	e = 0.556110	
i = 3.2737	1950.0	P = 6.17 years	

Date	ET	R. A. (1950)	Decl.	Delta	r	Elong.	Mag.
1984 03	01	04 10.12	+18 31.0	2.113	2.237	83.9	13.0
1984 03	06	04 15.59	+18 53.3				
1984 03	11	04 21.68	+19 16.2	2.175	2.174	76.7	12.9
1984 03	16	04 28.34	+19 39.2				
1984 03	21	04 35.56	+20 02.1	2.232	2.112	70.1	12.8
1984 03	26	04 43.32	+20 24.6				
1984 03	31	04 51.60	+20 46.2	2.281	2.051	64.1	12.7
1984 04	05	05 00.38	+21 06.8				
1984 04	10	05 09.65	+21 26.0	2.322	1.991	58.5	12.5
1984 04	15	05 19.38	+21 43.4				
1984 04	20	05 29.56	+21 58.8	2.355	1.931	53.3	12.4
1984 04	25	05 40.18	+22 11.8				
1984 04	30	05 51.21	+22 22.1	2.381	1.874	48.6	12.2
1984 05	05	06 02.65	+22 29.4				
1984 05	10	06 14.48	+22 33.5	2.399	1.818	44.3	12.0
1984 05	15	06 26.67	+22 33.9				
1984 05	20	06 39.21	+22 30.4	2.410	1.765	40.4	11.9
1984 05	25	06 52.07	+22 22.8				
1984 05	30	07 05.24	+22 10.8	2.417	1.716	36.8	11.7
1984 06	04	07 18.70	+21 54.2				
1984 06	09	07 32.41	+21 32.8	2.418	1.669	33.5	11.5
1984 06	14	07 46.36	+21 06.3				
1984 06	19	08 00.50	+20 34.8	2.417	1.627	30.6	11.4
1984 06	24	08 14.83	+19 58.1				
1984 06	29	08 29.32	+19 16.2	2.414	1.589	28.0	11.2
1984 07	04	08 43.94	+18 29.1				
1984 07	09	08 58.66	+17 36.8	2.411	1.557	25.6	11.1
1984 07	14	09 13.46	+16 39.6				

EPHEMERIS FOR P/WILD 2 (1983s) Cont.

Date	ET	R. A. (1950)	Decl.	Delta	r	Elong.	Mag.
1984 05	30	07 05.24	+22 10.8	2.417	1.716	36.8	11.7
1984 06	04	07 18.70	+21 54.2				
1984 06	09	07 32.41	+21 32.8	2.418	1.669	33.5	11.5
1984 06	14	07 46.36	+21 06.3				
1984 06	19	08 00.50	+20 34.8	2.417	1.627	30.6	11.4
1984 06	24	08 14.83	+19 58.1				
1984 06	29	08 29.32	+19 16.2	2.414	1.589	28.0	11.2
1984 07	04	08 43.94	+18 29.1				
1984 07	09	08 58.66	+17 36.8	2.411	1.557	25.6	11.1
1984 07	14	09 13.46	+16 39.6				
1984 07	19	09 28.31	+15 37.5	2.410	1.531	23.4	11.0
1984 07	24	09 43.21	+14 30.9				
1984 07	29	09 58.13	+13 19.9	2.411	1.512	21.4	10.9
1984 08	03	10 13.05	+12 04.9				
1984 08	08	10 27.96	+10 46.3	2.415	1.499	19.6	10.9
1984 08	13	10 42.85	+09 24.6				
1984 08	18	10 57.70	+08 00.1	2.425	1.494	17.9	10.9
1984 08	23	11 12.52	+06 33.4				
1984 08	28	11 27.29	+05 04.9	2.440	1.496	16.2	10.9

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ELEMENTS AND EPHEMERIS FOR PERIODIC COMET HARTLEY-IRAS (1983v)

T = 1984 Jan. 8.73855 ET
Peri. = 47°.14237 } 1950.0
Node = 0.80506 }
i = 95.71798 }

q = 1.2821694 AU
e = 0.8333606
P = 21.3 years

Date	ET	R. A. (1950)	Decl.	Delta	r	Elong.	Mag.
1984 02	20	20 47.59	+34 00.1	1.835	1.407	49.4	10.8
1984 02	25	20 47.25	+36 52.4				
1984 03	01	20 46.51	+39 55.9	1.787	1.468	55.2	10.9
1984 03	06	20 45.23	+43 11.5				
1984 03	11	20 43.15	+46 39.9	1.733	1.536	61.7	11.1
1984 03	16	20 39.95	+50 21.1				
1984 03	21	20 35.16	+54 14.9	1.682	1.611	68.5	11.2
1984 03	26	20 28.02	+58 19.9				
1984 03	31	20 17.29	+62 33.5	1.645	1.692	75.1	11.4
1984 04	05	20 00.82	+66 50.6				
1984 04	10	19 34.81	+71 01.8	1.634	1.776	80.9	11.6
1984 04	15	18 52.47	+74 50.1				
1984 04	20	17 44.11	+77 43.4	1.656	1.864	85.2	11.8
1984 04	25	16 08.70	+78 52.3				
1984 04	30	14 34.06	+77 49.0	1.717	1.954	87.6	12.1
1984 05	05	13 27.06	+75 07.8				
1984 05	10	12 45.88	+71 39.2	1.819	2.045	87.7	12.4
1984 05	15	12 20.81	+67 54.2				
1984 05	20	12 05.18	+64 08.1	1.956	2.137	85.9	12.8
1984 05	25	11 55.29	+60 28.3				
1984 05	30	11 49.07	+56 58.2	2.124	2.231	82.5	13.1
1984 06	04	11 45.30	+53 39.6				
1984 06	09	11 43.26	+50 33.0	2.313	2.324	77.9	13.5

EPHEMERIS FOR P/ENCKE (Based on elements published on MPC 7455)
(Magnitudes after Green and Morris 1981, ICQ 3, 10.)

Date	ET	R. A. (1950)	Decl.	Delta	r	Elong.	Mag.
1984 02	10	23 54.73	+07 33.9	1.567	1.070	42.4	11.1
1984 02	15	00 03.97	+08 22.9				
1984 02	20	00 13.92	+09 14.5	1.462	0.904	37.4	10.2
1984 02	25	00 24.59	+10 07.5				
1984 03	01	00 35.98	+10 59.9	1.318	0.728	33.1	9.3
1984 03	06	00 47.97	+11 47.7				
1984 03	11	01 00.15	+12 23.1	1.125	0.545	29.0	8.4
1984 03	16	01 11.35	+12 29.6				
1984 03	21	01 18.60	+11 32.9	0.876	0.385	22.6	7.5
1984 03	26	01 15.92	+08 34.0				
1984 03	31	00 58.20	+02 59.5	0.655	0.353	5.4	6.8
1984 04	05	00 31.42	-03 32.7				
1984 04	10	00 07.08	-08 45.1	0.640	0.486	23.3	7.0
1984 04	15	23 49.68	-12 07.8				
1984 04	20	23 38.34	-14 11.7	0.720	0.666	41.5	7.8
1984 04	25	23 31.09	-15 28.7				
1984 04	30	23 26.29	-16 19.8	0.793	0.846	54.5	8.6
1984 05	05	23 22.85	-16 57.6				
1984 05	10	23 20.00	-17 29.4	0.842	1.015	65.8	9.5
1984 05	15	23 17.24	-17 59.9				
1984 05	20	23 14.19	-18 31.8	0.868	1.174	76.9	10.3
1984 05	25	23 10.56	-19 07.3				
1984 05	30	23 06.11	-19 47.7	0.876	1.323	88.5	11.2
1984 06	04	23 00.61	-20 33.8				
1984 06	09	22 53.90	-21 25.5	0.876	1.462	101.1	12.0

EPHEMERIS FOR PERIODIC COMET SCHWASSMANN-WACHMANN 1 (1984 - 1985)

The following ephemeris is based on unpublished elements by Brian G. Marsden. The elements were obtained using observations from 1902 to 1983 and accounting for perturbations by the outer 5 planets. This comet is at quite large distances from both the comet and earth, and its "normal" brightness is between magnitudes 18 and 20. It does, however, experience outbursts which cause brightenings of 6 to 9 magnitudes on an irregular basis (there are usually at least one or two such outbursts per year). This ephemeris is provided so that observers can regularly watch for the flaring that is so characteristic of this short-period comet. The magnitude is the expected "normal" value based on an absolute magnitude of 7.5. See the text preceding these ephemerides for further information. [NOTE: There are some interruptions (a blank line) in the ephemeris below, in which a specific date is repeated twice (with perhaps slight differences in coordinates); this is due to the use of different sets of elements with different epochs. -- Daniel W. E. Green

Date	ET	R. A. (1950)	Decl.	Delta	r	Elong.	Mag.
1984 03	01	14 58.94	-27 24.4	5.849	6.252	109.6	19.3
1984 03	06	14 58.84	-27 32.2				
1984 03	11	14 58.45	-27 38.7	5.701	6.250	119.5	19.2
1984 03	16	14 57.78	-27 43.9				
1984 03	21	14 56.82	-27 47.6	5.568	6.248	129.4	19.2
1984 03	26	14 55.61	-27 49.8				
1984 03	31	14 54.14	-27 50.5	5.452	6.246	139.5	19.1

EPHEMERIS FOR PERIODIC COMET SCHWASSMANN-WACHMANN 1 (Cont.)

Date	ET	R. A. (1950)	Decl.	Delta	r	Elong.	Mag.
1984 04 05		14 52.44	-27 49.6				
1984 04 10		14 50.54	-27 47.1	5.360	6.244	149.5	19.1
1984 04 10		14 50.55	-27 47.1	5.360	6.244	149.5	19.1
1984 04 15		14 48.48	-27 43.0				
1984 04 20		14 46.28	-27 37.4	5.293	6.242	159.1	19.1
1984 04 25		14 43.97	-27 30.4				
1984 04 30		14 41.59	-27 22.0	5.254	6.239	166.9	19.1
1984 05 05		14 39.19	-27 12.3				
1984 05 10		14 36.80	-27 01.6	5.245	6.237	168.3	19.0
1984 05 15		14 34.47	-26 49.9				
1984 05 20		14 32.23	-26 37.6	5.265	6.235	161.8	19.1
1984 05 25		14 30.12	-26 24.7				
1984 05 30		14 28.16	-26 11.6	5.314	6.232	152.7	19.1
1984 06 04		14 26.39	-25 58.5				
1984 06 09		14 24.83	-25 45.4	5.389	6.230	143.0	19.1
1984 06 14		14 23.50	-25 32.8				
1984 06 19		14 22.42	-25 20.7	5.487	6.228	133.3	19.1
1984 06 24		14 21.60	-25 09.4				
1984 06 29		14 21.04	-24 58.9	5.605	6.225	123.6	19.2
1984 07 04		14 20.76	-24 49.3				
1984 07 09		14 20.75	-24 41.0	5.738	6.223	114.1	19.2
1984 07 14		14 21.01	-24 33.7				
1984 07 19		14 21.54	-24 27.7	5.881	6.221	104.9	19.3
1984 07 24		14 22.33	-24 23.0				
1984 07 29		14 23.39	-24 19.6	6.032	6.218	95.8	19.3
1984 08 03		14 24.70	-24 17.4				
1984 08 08		14 26.25	-24 16.6	6.186	6.216	87.0	19.4
1984 08 13		14 28.03	-24 17.0				
1984 08 18		14 30.03	-24 18.6	6.338	6.213	78.3	19.4
1984 08 23		14 32.25	-24 21.4				
1984 08 28		14 34.66	-24 25.3	6.486	6.211	69.9	19.5
1984 09 02		14 37.28	-24 30.3				
1984 09 07		14 40.07	-24 36.3	6.625	6.208	61.5	19.5
1984 09 12		14 43.03	-24 43.2				
1984 09 17		14 46.15	-24 51.0	6.753	6.205	53.3	19.6
1984 09 22		14 49.42	-24 59.6				
1984 09 27		14 52.83	-25 09.0	6.868	6.203	45.2	19.6
1984 10 02		14 56.37	-25 18.9				
1984 10 07		15 00.03	-25 29.5	6.967	6.200	37.2	19.6
1984 10 12		15 03.79	-25 40.6				
1984 10 17		15 07.65	-25 52.1	7.047	6.198	29.3	19.7
1984 10 22		15 11.60	-26 04.1				
1984 10 27		15 15.63	-26 16.3	7.108	6.195	21.6	19.7
1984 11 01		15 19.72	-26 28.9				
1984 11 06		15 23.87	-26 41.6	7.148	6.192	14.4	19.7
1984 12 06		15 49.28	-27 59.3	7.133	6.184	14.5	19.7
1984 12 11		15 53.50	-28 12.0				
1984 12 16		15 57.68	-28 24.7	7.083	6.182	21.9	19.7
1984 12 21		16 01.81	-28 37.1				
1984 12 26		16 05.87	-28 49.4	7.012	6.179	29.9	19.6
1984 12 31		16 09.85	-29 01.4				
1985 01 05		16 13.74	-29 13.2	6.921	6.176	38.0	19.6

EPHEMERIS FOR PERIODIC COMET SCHWASSMANN-WACHMANN 1 (Cont.)

Date ET	R. A. (1950)	Decl.	Delta	r	Elong.	Mag.
1985 01 10	16 17.52	-29 24.8				
1985 01 15	16 21.18	-29 36.1	6.811	6.173	46.4	19.6
1985 01 20	16 24.70	-29 47.1				
1985 01 25	16 28.07	-29 57.9	6.684	6.171	54.9	19.5
1985 01 30	16 31.27	-30 08.4				
1985 02 04	16 34.29	-30 18.6	6.544	6.168	63.5	19.5
1985 02 09	16 37.11	-30 28.6				
1985 02 14	16 39.71	-30 38.2	6.393	6.165	72.3	19.4
1985 02 19	16 42.09	-30 47.5				
1985 02 24	16 44.22	-30 56.6	6.234	6.162	81.3	19.4
1985 03 01	16 46.09	-31 05.3				
1985 03 06	16 47.69	-31 13.6	6.071	6.159	90.5	19.3
1985 03 11	16 49.00	-31 21.6				
1985 03 16	16 50.02	-31 29.1	5.909	6.156	99.8	19.3
1985 03 21	16 50.74	-31 36.3				
1985 03 26	16 51.15	-31 42.9	5.751	6.153	109.3	19.2
1985 03 31	16 51.23	-31 48.9				
1985 04 05	16 51.01	-31 54.3	5.603	6.151	119.0	19.1
1985 04 10	16 50.47	-31 59.0				
1985 04 15	16 49.63	-32 02.9	5.468	6.148	128.9	19.1
1985 04 20	16 48.49	-32 06.0				
1985 04 25	16 47.06	-32 08.1	5.351	6.145	138.9	19.0
1985 04 30	16 45.38	-32 09.2				
1985 05 05	16 43.46	-32 09.2	5.256	6.142	148.9	19.0
1985 05 10	16 41.33	-32 08.1				
1985 05 15	16 39.03	-32 05.8	5.186	6.139	158.6	19.0
1985 05 15	16 39.04	-32 05.8	5.186	6.139	158.6	19.0
1985 05 20	16 36.60	-32 02.4				
1985 05 25	16 34.07	-31 57.7	5.144	6.136	167.1	18.9
1985 05 30	16 31.48	-31 52.0				
1985 06 04	16 28.89	-31 45.2	5.132	6.133	169.9	18.9
1985 06 09	16 26.33	-31 37.4				
1985 06 14	16 23.84	-31 28.7	5.148	6.130	163.8	18.9
1985 06 19	16 21.46	-31 19.4				
1985 06 24	16 19.24	-31 09.5	5.193	6.127	154.6	18.9
1985 06 29	16 17.21	-30 59.2				
1985 07 04	16 15.39	-30 48.6	5.265	6.124	144.8	19.0
1985 07 09	16 13.81	-30 38.0				
1985 07 14	16 12.49	-30 27.4	5.360	6.121	135.0	19.0
1985 07 19	16 11.45	-30 17.1				
1985 07 24	16 10.70	-30 07.2	5.475	6.118	125.2	19.1
1985 07 29	16 10.25	-29 57.7				
1985 08 03	16 10.10	-29 48.9	5.606	6.115	115.7	19.1
1985 08 08	16 10.24	-29 40.6				
1985 08 13	16 10.69	-29 33.1	5.749	6.112	106.3	19.2
1985 08 18	16 11.43	-29 26.4				
1985 08 23	16 12.47	-29 20.4	5.900	6.109	97.1	19.2
1985 08 28	16 13.78	-29 15.3				
1985 09 02	16 15.37	-29 10.9	6.054	6.105	88.2	19.3
1985 09 07	16 17.21	-29 07.2				
1985 09 12	16 19.31	-29 04.3	6.207	6.102	79.4	19.3
1985 09 17	16 21.65	-29 02.1				
1985 09 22	16 24.22	-29 00.6	6.356	6.099	70.8	19.4
1985 09 27	16 27.01	-28 59.6				