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THE CHARACTERISTICS AND MOTIONS OF JUPITER'S SPOTS DURING A ONE-YEAR PERIOD

by

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Submitted to the Department of Meteorology on August 19, 1968, in partial fulfillment of the requirement for the degree of Master of Science.

Abstract -- The statistics of the spots in the belts of the planet Jupiter have been studied in the past only by visual observations. This report presents the results of the first phase of a pilot project utilizing the photographic patrol plates taken at the New Mexico State University Observatory. The beginning sections describe the earlier observing methods and summarize the characteristics of Jupiter's spots and zonal currents determined from the earlier techniques.

There follows a description of the N.M.S.U. plate collection and the methods used to order the photographic data into useable form. Nine synoptical photographic drift charts, showing the evolution of Jupiter's spots in nine zonal regions during the 1966-7 apparition, were constructed and data were taken concerning spot motions, shapes, sizes, lifetimes, etc. A computer was used to determine numerous characteristics of the spot populations in the individual currents and relationships between spot parameters. The resulting lists of observed spots form the first reasonably objective and uniform data sample on Jupiter's spots and the derived statistics and relationships form a source for comparison with theoretical models for Jupiter's circulation. Numerical results are presented herein covering Jupiter's entire northern hemisphere, with the exception of the equatorial jet, for the period November 1966 through November 1967 (but June to November 1967 is poorly covered because Jupiter was near solar conjunction).

The region of zonal shear bordering the equatorial jet is characterized by highly variable spot velocities and by shorter spot lifetimes. Unfortunately, lifetimes can be determined reliably for only a minority of spots, even in stable currents, and the apparent absence of strong correlation between size and lifetime requires further study. Small spots and dark spots may rotate more rapidly than large or light spots in some latitudes. The apparent preferred length for spots of 5^{o} may simply reflect loss of completeness of smaller spots; latitudinal widths of spots, generally about three-quarters of spot lengths are less variable than spot lengths. Many of the other potential correlations between spot parameters were found to be weak or absent. Tabulations of all observed spots and summaries of the findings concerning spot characteristics are presented in extensive appendices.

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I. INTRODUCTION

The planet Jupiter is less than a minute of arc in diameter as seen from the Earth. Nevertheless the gross pattern of the general circulation of the planet's atmosphere (at the height of the presumed "tropopause") has been ascertained to a degree not greatly inferior to our knowledge of the general pattern of the terrestrial circulation, at least until recent times. Indeed the oblateness of the planet, due to its rapid rotation, and the zonal cloud belts were recognized over three centuries ago, shortly after the invention of the telescope. In 1665 J.D. Cassini discovered a large South Tropical spot (probably the Great Red Spot; see Chapman, 1968a) and determined its rotation period. In subsequent years, Cassini measured changes in the motion of the Red Spot and also discovered the considerably more rapid motion of spots in equatorial latitudes (the equatorial acceleration).

Beginning about a century ago, amateur astronomers from many countries, but notably England, began to observe Jupiter regularly and to issue systematic summaries about the planet's telescopic appearance and the motions of spots in several well-defined zonal currents, based on visual timings of spot transits across Jupiter's central meridian. Such records through 1948 have been summarized by B.M. Peek (1958) in his comprehensive book, The Planet Jupiter.

Despite the magnitude of the accumulated data from amateur astronomers' observations, far less has been learned from such observations

than is possible using modern techniques. First, the visual observations of Jupiter suffer from their subjectivity and human errors. Secondly, the data sample is highly heterogeneous and the data reductions to date have been quite simple and in many ways incomplete and inadequate. The advantages and limitations of the past visual work are discussed in detail later.

Since the initiation of the first regular photographic patrol of Jupiter, now in about its sixth year at the New Mexico State University Observatory in Las Cruces, there is for the first time a large, uniform, objective record of Jupiter which is of sufficient quality to enable many kinds of investigations never before possible to be carried out with relative ease. The present report discusses an early phase of the first comprehensive analysis of a portion of the New Mexico photographic records.

The study is an outgrowth of an original investigation planned by Prof. Raymond Hide and the present author of the relationship between size and lifetimes of Jupiter's spots. In order to investigate one part of the lifetime spectrum (a few days to a year), a series of photographic charts were constructed from the New Mexico plates, designed to display in an orderly fashion (to be discussed in detail later on) synoptical pictures of Jupiter covering one apparition of the planet. (An apparition is a period of about 13 months measured from one solar conjunction to the next.) However, the charts provide a ready source of information on many other characteristics of Jupiter's spots and its currents than just the sizes and lifetimes. The present analysis is an attempt to learn about many aspects of Jupiter's visible atmospheric surface from these charts.

The intent is to derive empirical information concerning many characteristics of spots (including size, color, shape, motions, location,

etc.) and on the characteristics of the zonal currents. Some kinds of information which are gleaned from the charts simply refine cruder work already accomplished by amateur astronomers for the same period (e.g. Budine, 1968). Other characteristics which are investigated were suggested by terrestrial analogues with meteorological implications. Still other characteristics investigated are intended to be useful in other projects currently under way (for instance the size-lifetime study of Prof. Hide; also the study of momentum transfer in the Jovian atmosphere by Prof. Victor Starr and his collaborators).

The scope of this report is a limited one. By no means is it intended to be the last word on the characteristics of Jupiter's visible surface features. Rather, it is intended to be the preliminary first step in the objective analysis of Jupiter patrol photographs -- a pilot study. The coverage could be extended considerably now that several more years of patrol photographs have been taken, and better more automated techniques for analysing the photographic images are being devised (for instance by Starr's group). Some of the kinds of information and correlations developed here will justify further study in the future, while still other kinds of analysis can and will be performed using the present charts.

There is no attempt in this thesis to put forward physical hypotheses to help "explain" the relationships which appear. It would be far too premature to do so. Our knowledge of the physical nature of the belts and spots under investigation is so rudimentary that the first task must be to lay the empirical foundations. It is the purpose of this thesis (together with the already extant and long-term, though cruder, records of amateur astronomers) to form this empirical foundation.

Further development in several directions is planned. The preliminary data on the size-lifetime relationship presented herein will be amplified upon and presented, together with data on more long-lived spots and with a preliminary theoretical interpretation, in a report currently in preparation (Hide and Chapman, 1968). The present studies of the spot and current motions will serve as the basis from which the more sophisticated techniques of Starr et al will be developed in a theoretical-empirical study of the dynamical processes of Jupiter's general circulation. Another paper is planned which will use the present study as a basis for suggesting improvements in the traditional methods which amateur astronomers have been using for studying Jupiter; it appears likely that amateur data will be the primary source for much of our information about Jupiter's spots for some years to come.

Many of the characteristics of Jupiter's appearance and circulation appear to vary from year to year, but the present study considers only a relatively brief segment of time. Therefore, to establish the context of of the present results, it is necessary first to discuss the previous work by amateur astronomers -- both the results and the methods -- in considerable detail. This is the purpose of Section II. Section III then describes the techniques for obtaining the data used in the present study. The results, mainly tabular in nature, are presented in Section IV. Some implications of the results are discussed in the concluding section.

II. PREVIOUS STUDIES OF JUPITER'S SPOTS

Telescopic observations by amateur and semi-professional astronomers form the basis for most of our knowledge about the motions and characteristics of Jupiter's spots and currents. Through a telescope, Jupiter presents an elliptical disk about 40 seconds of arc in diameter. Lying parallel to the equator is a series of bright "zones" and dark "belts", the most prominent of which are in sub-tropical latitudes. Although these belts and zones vary in both darkness and width, and slightly in latitude, the major ones seem to have maintained their identity since Jupiter was first studied in the 1600's. Thus a standard nomenclature has developed; for instance from equator southward: Equatorial Band, Equatorial Zone (south portion), South Equatorial Belt (north component), South Equatorial Belt Zone, South Equatorial Belt (south component), South Tropical Zone, South Temperate Belt, South Temperate Zone, South-South Temperate Belt, South-South Temperate Zone, South-South-South Temperate Belt, and so on, with a similar nomenclature north of the equator.

Cassini's observations in the late 17th century provided the first evidence for the most important characteristic of Jupiter's circulation: the 5-minute shorter rotation period for spots within 10° of the equator compared with the $9^{h}55\frac{1}{2}^{m}$ rotation period typical for higher latitude spots. More recently about 20 distinct zonal currents have been recognized which are more or less, but not exactly, correlated with the visible belts and zones. The characteristics of these currents are described

following a discussion of telescopic observing methods.

A. Observing Methods

The typical telescope which has been used during the past century for accumulating data on Jupiter is between 4 and 12 inches in aperture, frequently a portable backyard reflector. (Occasionally large professional observatories have been used; sometimes small telescopes have been used for observing the largest spots.) Observers have been of all ages from early teens up and of many nationalities. In experience, reliability, and dedication, observers have ranged from the very able to the very casual. In general, however, most of the published reports are based largely on the extensive work by just a few devoted and experienced American and British observers who overwhelm the far larger number of more casual observers by the sheer quantity of their observations.

For about 3 months centered on solar conjunctions, Jupiter is quite unobservable. During the next several months, it is visible only in early morning hours when few observers can find the enthusiasm to make regular observations. Near times of solar opposition, the planet is above the horizon all night and many more observations are made -- mainly in the evening. As Jupiter again approaches conjunction, it is visible only in the evenings and usually is well-observed until it is lost in the glare of twilight. Not all apparitions are equally favorable. For most observers, but particularly for those in high latitudes such as in England, Jupiter's 12-year cyclical journey through the zodiac is crucial, and not just because of seasonal differences in the observing climate. When Jupiter is in Gemini, it can rise higher than 60° in the sky over England, and remain

above the horizon for over 15 hours. But 6 years later, when it is in Sagittarius, Jupiter never attains 20° and even then swiftly sinks below the horizon again. Since the small-scale turbulence in the terrestrial atmosphere ("seeing"), which is so important for resolving spots in Jupiter's image, is a strong function of zenith angle (mainly due to increased airmass), it is very difficult to obtain good observations from England during those years when Jupiter is in the southern constellations of the zodiac. It is important to recognize that these and other factors strongly affect the uniformity of Jupiter observations; for instance, the similarity between Jupiter's zodiacal period and the sunspot cycle renders uncertain apparent correlations between the solar cycle and Jovian phenomena.

About four chief kinds of visual observations of Jupiter have been made during the past century with some uniformity: drawings, descriptive notes and photometry, latitude measurements, and central meridian transits. We will be concerned chiefly with the last kind of observation which yields information on longitudinal (zonal) motions of spots.

Drawings. Hundreds of pencil sketches of Jupiter are made each apparition. They are drawn in 10 to 20 minutes (before significant rotation has taken place) on blank disks of Jupiter's ellipticity. The human eye is a more versatile detector than the camera, chiefly because it can perceive small features during occasional brief intervals of good seeing; photographs are usually taken at random intervals, and in any case they integrate the image over the exposure duration (usually a fraction of a second to a couple seconds). But although drawings by an able, accurate artist are superior to photographs in some ways (especially in resolution of small spots), they rarely turn out that way in practise. Many drawings fail because of subjectivity or carelessness, frequently on the part of

inexperienced observers. However, prior to the recent establishment of a photographic patrol, good photographs were not generally taken at sufficiently frequent intervals to form nearly as complete a record of Jupiter's appearance as that formed by the multitude of sketches. Fortunately, studies show (e.g. Chapman, 1962) that when data taken from drawings made by reliable observers are corrected for each observer's systematic positional errors, surprisingly high precision can be obtained from drawings ($1\frac{1}{2}^{\circ}$ in latitude, $2\frac{1}{2}^{\circ}$ in longitude are typical errors at the center of the disk). However, drawings almost never have been analysed in an orderly fashion and hence are not a source for reduced information about Jupiter.

Descriptive notes. Amateur astronomers frequently write descriptions of the planet each evening, including estimates of the color and relative conspicuousness of the belts and zones, as well as comments on noteworthy spots and suspected changes from previous days. Sometimes attempts are made to estimate the relative brightnesses of surface features on a numerical scale; these estimates could be calibrated to yield useful photometric data, but never have been in practise.

Latitude measurements. With rare exceptions, measurements of latitudes have been restricted to the latitudes of the edges of the belts and zones so little data is available on individual spots. Micrometers were often used for these measurements, but more recently measurements from occasional photographs have usually sufficed for this purpose.

Central meridian (CM) transits. Probably the most useful data to planetary science assembled by amateur astronomers is information obtained on the longitudes of Jovian spots from several million timings of passages of spots across the central meridian of the planet. The observing procedure is quite simple: the observer merely estimates to the nearest

minute the time at which each spot visible rotates across the vertical meridian bisecting the illuminated disk of Jupiter. The observer records each such timing along with a brief description of the spot (usually limited to its approximate latitude, relative to one of the visible belts, and whether it is bright or dark). The longitudes of the spots are then quickly determined from CM tables in an ephemeris such as the American Ephemeris and Nautical Almanac (AENA). Longitudes are determined relative to one of two longitude systems rotating with arbitrary periods which approximate the periods for equatorial spots (System I, $9^h50^m30.003^s$) or the higher latitude periods (System II, $9^h55^m40.632^s$).

Longitudes determined from CM transits are subject to several systematic errors. First, different observers show differing susceptibilities to "phase exaggeration" which yields a systematic longitudinal bias that varies with the sun-Jupiter-earth phase angle. Secondly, observers have their own personal high or low biases, which may or may not be stable with time. Both kinds of systematic biases can amount to more than 2° of longitude. Reese (1962) has shown that the accidental error in longitude (after correction for biases) is less than 1° for a good observer. Unfortunately, CM transits are rarely corrected for systematic errors in published reductions.

B. Reductions of Amateur Data

Published reductions of CM transit data by such organizations as the Association of Lunar and Planetary Observers and the British Astronomical Association are usually based on several thousand CM transits submitted by several dozen different observers during the course of an appari-

tion. The Jupiter Directors who have performed the reductions are intelligent and competent, but as unpaid amateur astronomers they have usually lacked the time to obtain more than the bare essentials from the data. This is all the more unfortunate now since much of the original data has been lost or thrown away.

The method of reduction is as follows. From experience, the typical latitudinal extents of the several zonal currents are known, so a separate graph can be made for each current. All CM transit longitudes for the particular current (horizontal axis) are plotted against date, (increasing downwards), using different symbols to distinguish dark spots from white ones and timings of the preceding or following ends from those of the centers. The prominent well-observed spots are immediately identifiable on such a graph as a string of points, perhaps slanting to the right or left depending upon whether the spot is moving more slowly or more rapidly than the adopted longitude system. Lines are drawn to connect the points for the identified spots. The identification of the more inconspicuous or transient spots is more uncertain. There is the danger of connecting several points which do not refer to the same atmospheric feature. The determination of whether several points do represent a single feature rests on a number of factors: the closeness of fit to a straight drift line (indicative of a uniform rotation period), the similarity of the apparent rate of drift to other spots in the same latitude, and the lack of possible ambiguity in connecting spots over a long observational gap. Comparisons of independent reductions of transit data during the same apparition suggest that overly optimistic identifications have frequently been made. Bias is undoubtedly introduced by the subjectivity of this kind of decision-making.

The published reports usually contain the following information for each identified feature: dates and longitudes when first and last recorded, the mean longitudinal drift per 30 days, and the corresponding rotation period. There is occasionally a brief description of the spot beyond the simple designation of dark or bright. Mean drifts, and hence mean rotation periods, are obtained for each current, usually unweighted averages of the drifts of all spots deemed to be in the current.

Without belittling these valuable reports, or their general reliability, it is nevertheless worth noting that ideally far more could have been done, and still can be done for future apparitions and even for past ones for which the original data still exists. For instance, in recent years largely independent reports have been issued by groups in many different countries, including the United States, Japan, England, Switzerland, Italy, and others. It is unfortunate that attempts to pool all the data have so far failed. Secondly, few attempts have been made to eliminate observations by unreliable observers, to weight or interpret data to take into account differing telescopes or seeing conditions, to determine and correct for personal systematic errors, or to use standard statistical procedures for determining the reliability of spot identifications. Thirdly, there has been little or no attempt to use other kinds of data (such as drawings, existing photographs, or written notes) in conjunction with the transit data. For instance, since spots occur in many different shapes and sizes which are often stable, checking photographs or drawings could improve the reliability of spot identifications; they could even be used to fill in gaps in the CM transit coverage. Finally, the many other important characteristics of spot motions besides the average motion are lost, except in those relatively infrequent cases when the

original drift charts have been published.

I should repeat that to perform the kind of improved analysis suggested above would take much more time than even the most devoted amateur astronomer could volunteer; in fact, it would take more time than the analysis of the photographs reported on in this thesis. Nevertheless, it may well prove desirable to perform such reductions on a pooled collection of amateur Jupiter observations plus existing photographs for apparitions prior to the establishment of photographic patrols. I expect such analyses could approximate the accuracy of the present preliminary reduction of the patrol photographs.

C. Characteristics of Jupiter's Circulation -- Early Results

The results of amateur astronomers' observations of the motions of Jupiter's spots have been published in numerous reports and journals during the past century, some of them available in observatory libraries, but most of them small, sometimes mimeographed, publications of limited distribution. Perhaps the chief sources for reduced Jupiter data covering the period 1891 to 1948 are the regular, orderly, and complete reports of the Jupiter Section of the British Astronomical Association issued until 1943 as Memoirs of the British Astronomical Association and thereafter as reports in the Journal of the B. A. A. An excellent summary of these observations has been given wide distribution as the book, The Planet Jupiter by B. M. Peek; however, the original reports should be consulted for serious investigation of past work. For apparitions since 1948, a superior source for Jupiter rotation data are the usually regular reports of

the Jupiter Section of the Association of Lunar and Planetary Observers, published in the Journal of the Association ("The Strolling Astronomer"). These reports, prepared until recently by Mr. Elmer J. Reese, are of exceptional quality.

I now describe what I feel are the pertinent characteristics of Jupiter's motions based on my familiarity with the literature and on several unpublished analyses I have made based on the above sources. Comparisons of independent reductions of spot data suggest that the published tables generally provide a reliable picture of the characteristics of Jupiter's circulation, even though misidentifications occur. The mean rotation period for a single spot can usually be determined to better than 1 second, although spot motions frequently fluctuate about the mean by a second or more.

If one plots mean rotation period versus Jovian latitude, the most obvious feature is the equatorial acceleration: within a degree or two of both $+10^{\circ}$ and -10°, spots switch from a rotation period similar to that of most higher latitude spots of about $9^{h}55^{m}$ to a period of about $9^{h}50\frac{1}{2}^{m}$, which is characteristic (usually to within $\frac{1}{2}^{m}$) of spots at all latitudes between + and -10°. The non-equatorial regions of the planet do not rotate exactly as a solid, even in the long-term average (Chapman, 1968b). The two hemispheres are not symmetric. The shortest average periods are in south temperate latitudes (about $9^{h}55^{m}$), with somewhat longer periods both poleward and equatorward. The longest average periods are in north temperate latitudes, with shorter periods both equatorward and poleward. In addition to this average pattern are two well-defined latitudes of transient, semi-periodic anomalous periods: the longest occur in south

sub-tropical latitudes (about 9^h58^m during the South Equatorial Belt disturbance) and the shortest in north sub-tropical latitudes (around 9^h49^m). Superimposed on this general picture are both spatial and temporal fluctuations.

I now define the word "current" as I use it. Loosely, currents are the various latitudinal zones possessing different mean rotation rates. More precisely, a current is a particular rotation period or velocity which, for many years, is characteristic of a large fraction of spots in a particular latitudinal zone. Thus a current is not defined so much by the belt it is in, or even its latitude, as by its characteristic rate. It often happens that spots in closely adjacent latitudes (or even the same latitude) follow the motions of two distinct currents. It also happens that spots in a particular belt may follow the rate of one current during some years and another current during others. Some currents seem more stable in latitude than some belts. Reese and Smith (1966) have shown that the rapidly-rotating spots in north temperate latitudes (about 24° N.) are manifested on periodic occasions when the North Temperate Belt (NTB) shifts southward into that latitude. On the other hand, there is evidence that the S. S. Temperate Current extended its influence equatorward around 1940 when spots on the sough edge of the STB, which had been rotating about 15 seconds faster at a period corresponding to that of the S. S. Temperate Current. The mean rotation period of a current can differ by several seconds from year to year; these are real changes, not statistical fluctuations. Some currents, such as the S. S. Temperate Current are more stable from year to year than others. For most currents the rates are often similar from year to year followed by rapid accelerations or decelerations which mark the start of a new regime which may last for

several more years before a return to normal.

Most currents have fairly sharp latitudinal boundaries, and the characteristic rotation periods usually differ by substantially greater amounts than the typical variations from year to year or the deviations from the mean of different spots within a current. That is, "currents" seem to be fairly well-defined entities and are not just arbitrary subdivisions of a smoothly varying latitudinal dependence of wind velocity.

The average rotation periods for individual spots generally differ by only a few seconds from the mean for the current it is in. Sometimes there are temporary groups of spots, separated from each other by longitude around the same latitude circle, which move either somewhat faster or slower than the mean for a current.

Apart from the rotation periods for a current as a whole, or its longitudinal sections, individual spots have their own characteristic behavior. Published and un-published drift charts for the N. Eq. Current suggest that most North Equatorial spots undergo relatively rapid oscillations about their mean longitudinal drift; though non-periodic, the oscillations result in shifts of as much as 10° in a single month. The present analysis of photographs shows that this behavior is specially peculiar to the N. Eq. Current. Published drift charts also indicate occasions when spots suddenly accelerate or decelerate and adopt a lasting new mean rotation period which may differ by many seconds from the previous period. Such changes can occur either as part of a change in a whole current or section, or can be quite individual. Such rapid and unpredictable changes in motion make it difficult to trace and identify spots through even short gaps in observations.

As discussed earlier in this section, these finer aspects of spot motions have never been systematically studied from either amateur observations or from photographs, even though suggestions of typical behavior can be seen on the crude drift charts based on CM transits. The important point of this section is that while there is regularity and uniformity in the characteristics of Jupiter's circulation over the past century, or longer, it is also true that many of the characteristics show temporal variations. Therefore, the results of the present analysis must be taken as representative of Jupiter's circulation only during the period under study. Certainly some gross characteristics derived for one year will exemplify Jupiter's behavior at all times. At least some of the finer aspects of the statistics may be expected to be approximately typical for a given current, but likely not to within the measured statistical error since other characteristics of currents are known to vary from year to year. Certainly the value of the present investigation will be enhanced if it is repeated for other apparitions so that the nature and magnitude of year-to-year changes in the statistics can be ascertained.

A final word of caution is necessary before describing the project. This is simply an empirical study, with no presumption to attempt a physical explanation at this time, and it should be emphasized that we are uncertain yet as to just what we are measuring the motions of when we observe "spots". It would be naive to assume that the "spots" are dynamically neutral "wind markers". Spectroscopic observations suggest that the true rotational velocity of Jupiter's atmosphere above the cloud surface approximates the velocities obtained from spots, but the precision is poor. Motions of terrestrial cyclones and anti-cyclones, which may be the analogues of Jupiter's spots, have been shown to duplicate in relative

directions but not in absolute magnitudes some of the true dynamical elements of the terrestrial circulation (Macdonald, 1967).

III. THE METHODS USED FOR OBTAINING DATA ON JUPITER'S SPOTS FROM THE PHOTOGRAPHIC PATROL

A. Construction of Photographic Drift Charts

The early phases of planning the construction of the charts which were eventually used as the basis for the present investigation, although carried out mainly by myself shall not be construed to be strictly part of the work on this thesis, since much of it was done prior to my enrollment in M. I. T. Nevertheless, since these charts form the basic source for the data used in the thesis, it is necessary to discuss their format and preparation in some detail for background purposes. This is the first such description of the preparation of the charts.

The Patrol Photographs

The original source of the photographs is the plate collection at the New Mexico State University Observatory on the campus in Las Cruces, New Mexico. The plate collection covers the period of the current decade, but until about 1964 the coverage was less complete and the photographic quality not as high as in later years. Prior to February 1967, a 12-inch

aperture reflector, located on Tortugas Mountain, was used for the patrol photography. Since then, a 24-inch Boller and Chivens Cassegrain instrument has been installed on Tortugas Mountain as the patrol telescope. Two photographers work on alternate nights to obtain patrol photographs of Venus, Mars, and Jupiter, and more irregular photographs of the other planets. Photographs are regularly taken with filter-plate combinations sensitive to red, green, and blue wavelengths. Occasional photographs are also taken on ultraviolet or infrared sensitve plates and on panchromatic plates.

The New Mexico photographic patrol of Jupiter is <u>not</u> continuous; there are the many gaps necessary because Jupiter is too near the sun, or below the horizon, or behind a cloud, or a particular Jovian longitude is not facing the earth. Also, because of the extreme rarity of perceivable changes in Jupiter's surface features during the course of rotation across the disk, it is only necessary to photograph Jupiter once every 2 hours, or so, to insure complete coverage as the planet rotates beneath us. But mainly in the interests of economy, the New Mexico patrol is somewhat less complete than ideal. Coverage is often omitted in order to photograph the other planets, or because the seeing conditions are rather poor, or because good coverage was acheived just the night before, or for a host of other reasons. There is a general attempt to cover a particular Jovian longitude at least twice a week. On the average, the coverage is this good or better during the middle months of an apparition. Sometimes an extra effort is made to photograph particular surface features which yields superior coverage for certain longitudes compared with others.

The various scheduling procedures plus unpredictable circum-

stances such as cloudy weather occasionally result in gaps in the coverage in one of the regular colors near a particular longitude of up to a month even in the middle of an apparition. There are also cases of nearly daily coverage of a particular longitude for a week or two.

The patrol photographs are not at all of equal quality. The resolution in the images is a function of many factors of which the most important is the "seeing" condition -- small-scale turbulence in the terrestrial atmosphere which either causes "excursion" of Jupiter's image across the plate during an exposure, or simply makes the whole image fuzzy. The seeing varies from second to second; thus many individual exposures must be made to obtain good images even though, as at the N.M.S.U. Observatory, the photographer is monitoring the seeing visually at the same time. A typical N.M.S.U. plate has several dozen images taken during the course of several minutes. (The time of each image is accurately recorded.) The average seeing also varies from day to day with changing weather and over the course of an apparition (early and late in an apparition Jupiter must be observed when low in the sky where seeing is bad). All N.M.S.U. plates are examined and the better images on each are marked. Also a rating of the average quality of the better images is made on an A,B,C,D,E scale; these ratings are found to correlate closely with the photographers' estimates of the seeing conditions recorded during the observation period.

The Photographic Prints

I decided that the best way to order the New Mexico data was to construct "drift charts" analogous to those used for the analysis of CM transits, except to substitute photographic strips -- which convey full information on not only spot longitudes but also their sizes, shapes,

brightnesses, relative latitudes, etc. -- in place of the simple symbols used to represent CM transit longitude determinations. By constructing a separate chart for each latitudinal zone, and laying photographic strips horizontally on the chart, with left-right position determined by the longitude of the central meridian, and nesting them beneath each other with increasing date, it is possible to follow at a glance the development and evolution of an entire zone during the period covered by the chart. This technique, while less sophisticated than the very difficult task of constructing time-lapse movies from the plates, and somewhat less precise and objective than machine measurement and interpretation of the plates, is well-suited for a relatively rapid, inexpensive pilot project with the aim of establishing the general characteristics of Jupiter's evolution during an apparition.

I decided to construct nine charts covering Jupiter's entire surface with nine slightly overlapping zones. Since maximum coverage was desirable not only for the size-lifetime study but also for other general studies of Jupiter such as those described in this thesis, all available non-redundant plates were used during the year best covered by high quality plates. Examination of several years of patrol plates suggested that the time coverage during the latest complete apparition (1966-1967) was at least as good for previous apparitions, and the quality of the plates was somewhat better, mainly due to the installation of the larger telescope in the middle of the apparition. The period selected included the entire 1966-1967 apparition plus the tail end of the previous apparition and the early beginnings of the 1967-1968 apparition (19 months including the two long gaps near solar conjunctions). The charts on which the present study is based cover only the final three-quarters of the 1966-7 apparition and

the beginning of the next apparition (one year, including one long gap); charts for the earlier photographs, many of relatively poor quality, are not yet completed.

Photographs of Jupiter in different colors show substantially different surface features. In order to avoid the confusion of mixing photographs of different wavelength sensitivity, separate charts were made for long-wavelength photographs (red and near infrared) and for short-wavelength photographs (blue and near ultraviolet). Since green plates show features intermediate in appearance between red and blue, redundancy was reduced by omitting any charts based on green photographs, but using green photographs, when appropriate, to fill in lengthy gaps in coverage on both the blue and red charts. All the blue and red plates were used except those for which the quality rating was D or less and except for those which provided only redundant coverage of a particular longitude already covered by adjacent photographs taken the same night. Even poor quality plates were used when required to fill a gap in the coverage.

The best images were selected from the chosen plates and used for making positive prints on flat-lying semi-matte Cronapaque paper. Using the known plate scales, the ephemeris for the true angular diameter of Jupiter from date to date (A.E.N.A.), and a new calibration of the magnifcation of the enlarger in the N.M.S.U. Observatory darkroom, it was possible to print all the photographs to the same scale -- 5.45 cm to Jupiter's polar diameter. A small exposure meter was used in a not-always-successfu attempt to produce prints of uniform average brightness.

By projecting the image onto the paper through a special photographic plate overlay, it was possible to superimpose on all prints an

accurate outline of Jupiter and other identifying marks used later in preparation of the charts. A fine white line was superimposed on all prints bisecting the Jupiter outline to serve as a marker of the central meridian for pasting photographic strips at the proper longitudes on the charts. Also superimposed on the prints were the meridians for $\pm 35^{\circ}$ from the CM. Because surface spots on Jupiter lose their contrast away from the center of the disk, I decided to use only the central 70° for placement on the charts; hence the $\pm 35^{\circ}$ meridians indicated where the ends of the strips were to be cut off. Foreshortening results in a maximum displacement at the edges of the strips $2^{\circ}.2$ in longitude -- sufficiently small to be easily taken into account in analysing the charts. Also superimposed on each print, exterior to the image of the planet itself, were series of marks indicating the edges of the nine chosen latitudinal zones to serve as guides for the print-trimmer. Since the nine zones are slightly overlapping, two identical prints were made of each photograph for staggered cutting.

A print of the plate overlay was placed in the movable paper-holder so that Jupiter's image could be centered correctly before inserting the unexposed paper and lowering the plate overlay (fastened to the paper holder). Because of the non-symmetrical brightness distribution across the image of Jupiter, except near opposition, caused by the sun-Jupiter-earth phase angle, some bias is necessarily introduced in centering the image (phase exaggeration). Mr. Elmer Reese, who is familiar with correcting for phase exaggeration, helped to guide the darkroom assistant to make appropriate though subjective corrections for phase exaggeration, but long-term systematic bias of perhaps two degrees is undoubtedly still

present. Random error in centering probably amounts to less than one degree. The orientation of the centered image of Jupiter was relatively easy to accomplish because of the planet's prominent belts parallel to the equator; in any case the precise orientation is not crucial.

To minimize the effect of the discontinuity in longitude at the left and right ends of the charts (0° and 360°), all images with central meridians within about 25° of either 0° or 360° were printed twice (4 prints) so that they could be pasted at both ends of the charts.

The Charts

Approximately 700 separate images of Jupiter were used to construct 18 charts which depict the evolution of Jupiter's surface features in two colors (red and blue) for the nine different latitudinal regions. The charts currently cover the 1966-7 apparition from November 2 through its conclusion (last photograph June 14) plus the very beginnings of the 1967-8 apparition during the period Sept. 30-November 14. Table 1 presents the relevant information about the charts. The central latitude is the zenographic latitude*, approximately in the center of the latitudinal region covered by each chart, for which the longitude scale was chosen in positioning the photographs. Clearly, because of the different lengths of latitude circles, the adopted longitude scale on each chart is slightly too expanded for spots poleward of that latitude. The choice of this central latitude in each zone was weighted toward the latitude where spots were

* Actually the latitude assumes that Jupiter's axis is exactly perpendicular to our line of sight. In fact, Jupiter's north pole was tilted towards earth during this period by a varying amount of somewhat less than 1°.

most prevalent. The next column lists the abbreviations of the important belts and zones covered by each chart. The penultimate column lists the ratio in length of 1° in longitude at the central latitude to 1° at the equator; this is useful because later analyses record spot lengths in degrees rather than absolute lengths. Note that the longitudinal scale on the charts is such that 1° at the equator = 0.20 inch. The vertical daily spacing of the photographic strips is given in the last column in inches. Because of this wide spacing necessitated by the width of the strips, between 2 and 3 pieces of cardboard 30 inches long were required to cover the 225 last days of the 1966-7 apparition for each chart.

The photographic prints were sliced into strips with a print-trimmer. The foreshortened ends of the strips were cut off with scissors, and the resulting parts rubber-cemented onto the white cardboard charts positioned with the aid of accurate longitude rules for each chart. In cases where two strips overlapped, some effort was made to place the better one on top. The resulting charts are a montage of strips which when viewed from a distance seem to show little uniformity in tone, few spots, and quite random spacing. Although it was not planned that the charts would ever be striking pictorial exhibits of Jupiter to the untrained eye, the variable darkness of the strips is disconcerting and makes any attempt to copy the charts for illustration in this thesis quite impossible. The variable brightness of the strips is due partly to uneven darkroom procedures, partly due to poor quality control by the photographic paper manufacturer, and partly due to the innate variability in the plate images affected by observing conditions, plate characteristics etc. To the observant eye, however, these non-uniformities are relatively unimportant, and hundreds of spots can be discerned and traced from day to day. Of

more concern are the gaps in coverage, caused either by poor photographic quality usually caused by poor seeing conditions, or else by a complete lack of photographs of a particular longitude during a lengthy interval. The proper sorting out of the real characteristics of the Jovian spots from the bias due to such coverage problems is a difficult task. The following sections describe my preliminary attempt to obtain this information.

TABLE I

Chart	Central Latitude	Belts and Zones Covered	Ratio 1° Long at Central Lat.* to 1° at Eqat.	Daily Spacing (in.)
I	43°	NPR (south), NNTB, NNTBs	0.758	0.0350
II	27½	NNTBs, NTeZ, NTB, NTrZn	0.899	0.0300
III	18	NTBs, NTrZ, NEBn, NEBZ	0.957	0.0300
IV	5½	NEBZ, NEBs, EZn, EZs	0.996	0.0417
V	-9	EB, EZs, SEBn	0.990	0.0300
VI	-17½	SEBn, SEBZ, SEBs	0.961	0.0300
VII	-24	SEBs, STrZ, STB	0.929	0.0300
VIII	-34	STB, STeZ, SSTBn	0.851	0.0350
IX	-48½	SSTB, SSTeZ, SPR (north)	0.688	0.0300

B. Reduction of Spot Statistics from the Drift Charts

Tracing Spots on Overlays

Before one can compile statistics on the spots, one must iden-

*Refers to unforeshortened longitudes near the central meridian; 1° at equator = 0.2 inches on the charts.

tify the spots. In particular, one must unambiguously trace the spots from day to day if one is to obtain any information on spot motions or evolution. As suggested in Section II B, this is a difficult task. Fortunately it is comparatively easy to discern continuity of spots from the numerous characteristics revealed in complete photographs of the spots.

Nearly every current has a variety of large, prominent, relatively long-lived spots whose drifts from day to day are clear. These spots serve as markers, and the motions and development of smaller spots can be traced in relation to the larger ones. Because of the lucid presentations of the evolution of a region on the charts, one quickly develops an impression of the qualitative characteristics of the spot appearances, motions, and changes which allows one to form subjective but realistic decisions concerning the reliability of interpreting a pair of spots observed on different days as the same spot. As discussed earlier, this approach is a substantial improvement over earlier drift charts, based on largely heterogeneous data on spot longitudes only. Nevertheless, the present techniques are inferior to what can eventually be acheived by objective analysis of the patrol data. But in order to establish meaningful criteria to serve as the basis for programming the objective decision-making routine, it is necessary to make a pilot study such as the present one which provides an approximate basis for choosing realistic criteria.

Pencil lines connecting identical spots were drawn on transparent matte-surface overlays. First a symbol was recorded on the overlays to signify each visible spot. Subsequently, after careful attention was paid to all the details visible in the photographs, solid lines were drawn connecting the obviously-identical spots. Dashed lines were used to

connect spots deemed to be probably identical, and dotted lines used for possibly identical spots. In doubtful cases, of which there were many (particularly for smaller spots), no lines were drawn. The process was then iterated to insure that all spots down to a uniform standard of reliability were marked and that complete and uniform construction of the drift lines was achieved. The use of different symbols helped to distinguish spots of different sizes and colors. Lines of different colors were used to plot drifts for spots in adjacent but different latitudes which frequently have different average drifts.

It was not easy to maintain uniformity and reasonable objectivity when marking spots and then drawing drift lines. It is easy to see small, rather vague spots on an otherwise featureless belt when spots of equal or greater size or contrast can be missed amid the general confusion of such a belt as the NEB. Also, it is undoubtedly the case that an isolated spot moving with a greatly different velocity from its neighbors (or rapidly oscillating in velocity or latitude) would be harder to detect than a similar spot moving in a normal fashion. Also there is the "zebra problem"; whether to call an assemblage of spots dark spots on a light background or bright spots on a dull background. In many cases there is no doubt as to whether the spots are mainly dark or light, but in some regions where the spots are ill-defined (such as the wavy edges of the SEB), my preference for seeing primarily dark spots might not be shared by others.

Measured Information about the Spots

From the innumerable kinds of data which could be measured con-

cerning each spot, I selected the following representative characteristics for the pilot study. They cover, in approximate form, most of the characteristics which can be obtained from the present charts in a reasonably short time. The information for each spot was punched on two computer cards.

Number: Each spot was given a number, ranging upwards from 1.

Latitude: The spots were placed in one of the following 24 latitudes. There are two numbers corresponding to the south component of the North-North-Temperate Belt; number 22 refers to spots seen on the north edge of the chart for the NTB, while number 23 refers to spots seen on the south edge of the chart for the NNTB.

1 SSTeZ	9 SEBsn	17 NEBZ
2 SSTB	10 SEBZ	18 NEBn
	11 SEBns	19 NTrZ
3 SSTBn		
4 STeZ	12 SEBn	20 NTBs
5 STB	13 EZs	21 NTB
	14 EB	22 NNTBs
6 STBn		
7 STrZ	15 EZn	23 NNTBs
8 SEBs	16 NEBs	24 NNTeZ

Number of observations: This is the approximate number of dates on which the spot was recorded.

Dates observed: The first and last dates on which the spot was definitely recorded are given. These dates are the same if the spot was seen only once. The 225 days of photographic coverage were numbered consecutively from 1 to 225 (1 = November 2, 1966).

Reasons why not observed before or after: There are many reasons why a spot is not seen before or after certain dates. Perhaps the spot disappeared, or perhaps the coverage was poor, or other reasons. Nine reasons, or combinations of reasons, are listed below. For each spot, two numbers were recorded -- one giving the reason why the spot was not seen earlier, one why it was not seen afterwards.

0 = The spot definitely was not formed or definitely disappeared. This includes the cases when smaller spots either emerged from or merged into larger spots.

1 = The spot probably was not formed or probably disappeared (including probable merges).

2 = The spot was vague or small and was only marginally observed in any case.

3 = There were lengthy gaps in the photographic coverage either before or after the spot was observed rendering identifications uncertain.

4 = There were many nearby similar spots, perhaps exhibiting rapid relative motions, rendering the identification of the spot ambiguous.

5 = Combination of 2 and 3 above. The spot was vague and the coverage was poor.

6 = Combination of 2 and 4 above. The spot was vague and crowded by similar spots.

7 = Combination of 3 and 4 above. There was poor coverage and the spot was crowded.

8 = The spot continued to exist but had substantially changed its appearance.

9 = The spot could not be followed because one end of its lifetime extended into the time either before or after the photographic coverage of the 1966-7 apparition.

Dates definitely not extant: For those spots which were recorded as either

definitely not formed or definitely disappeared, the previous or following dates are given on which there is definite photographic evidence that the spot was not extant. These dates help establish upper limits to spot lifetimes.

Positions at thirty-day intervals: The longitudes of the spots were recorded for days numbered 15, 45, 75, 105, 135, 165, and 195 if the spots were extant on any of those days.

Typical deviation from uniform drift: Different spots show differing tendencies to meander about a straight line drift. For each spot which lasted at least 30 days, an estimate was made of the typical short-term deviation of the spot (in degrees) from its mean drift during a 30-day period. These are listed in the tabulations in the appendix in the column labelled "DEV".

Dates of special prominence: Some spots are visible for a long time, but have a period or two of unusual prominence. The beginning and ending dates of such periods were recorded when applicable.

Spot description: In order to approximately identify spots by appearance, the following classifications were applied: (1) Light or dark. (2) Fuzzy, medium, or sharp in general outline and distinctiveness. (3) Spot proportions: spot length about 3 times its width or longer, spot about 2 times its width, spot about as wide as it is long, spot about twice as high as it is long, and spot much taller than it is long (length here refers to longitudinal extent). Some Jovian surface features are borders and are not characterized by lengths or proportions -- this was noted in such cases. (4) Spot type: round or oval, festoon, wavy edge or projection

from a belt or zone (either dark or light), angular shaped spots, amorphous spots, variable shape, preceding border, or following border.

Spot lengths: The maximum and minimum lengths of spots were recorded in degrees of longitude.

Spot continuations: It has already been pointed out that for several reasons, the continuous drifts of spots are interrupted by gaps in the coverage or for other reasons, and that in such cases of doubtful drifts, dashed lines were drawn on the chart overlays to indicate probable spot continuations and dotted lines to indicate possible continuations. In addition there are cases of merging or diverging spots, which themselves are either definite, probable, or possible. In all these cases, the continuations were noted by punching the reference numbers of adjoining spots on the computer data cards. In any cases of ambiguous continuations of spots, no more than one continuation is regarded as "probable".

Physically related spots: On some occasions, it is clear that several spots are physically related to each other. For instance, in the north edge of the NEB there was a small white spot surrounded by a much larger dark spot. It is possible that such combinations are in no way independent. The reference numbers of any closely related spots were punched on the data cards, though no use of such relationships was made in this preliminary study.

All of the above spot characteristics were recorded for the blue-light photographs of all currents except the North Equatorial Current. The spots in the North Equatorial Current, unlike the remainder of the planet, are much more prominent in red light. In a subsequent study, the red

light photographs of all belts, plus the relatively featureless blue-light photographs of the Equatorial regions, will be analysed to determine if there are any systematic differences in spot characteristics as a function of color. Partly in order to assure uniformity of the data analysed in this thesis, and partly because of difficulties in computer storage of the voluminous data on equatorial spots, discussion of the NEB regions is omitted from this report.

IV. COMPUTER ANALYSIS OF THE CHARACTERISTICS OF JOVIAN SPOTS AND CURRENTS

A. Spot Characteristics

The number of spots observed and the numerous computations necessary to derive all the atatistics desired required the use of a computer. A Fortran IV IBM 360 program of more than 1000 steps was written designed to execute the following procedures.

Definite, Probable, and Possible Spots

The data cards contain information on spots with definitely observed drifts or else spots which were definitely observed only once. Probable and possible spots were generated from series of definitely observed spots using the continuation reference numbers and the following

conventions. Many of the probable and possible drift lines drawn on the chart overlays are of a branching nature -- i.e. they indicate either merges or else ambiguous continuations of which only one may be the correct one. One could study all possible combinations and permutations of spots formed by the probable and possible drifts, but for our purposes this would be mis-representative. For instance, in the case of the two prominent merging spots in the NEBn, such a procedure would give lifetimes for both of upwards of 6 months. But, since during the last 4 months of this period there was only one spot where there had been two, one clearly had disappeared and both did not last 6 months. Also, to follow both paths in cases of ambiguity, clearly would not represent the real situation, whereas to choose and follow just one path in an ambiguous case at least may represent what really happened.

Therefore I have traced probable and possible spot drifts using the same convention in which rivers are usually named. At each juncture of two spot drifts (whether due to ambiguity or real merges), only one is traced past the juncture and the other is regarded as either having disappeared (or appeared in cases of divergence). Probable spots are taken as those singly observed spots and definitely traced spots which are connected by one or more probable drift lines. Possible spots are those definite spots and probable spots which are connected by one or more possible drift lines.

Some of the statistics compiled below are considered separately for each possible grouping of the observed spots. The statistics for definite spots may be regarded as providing the most reliable information on spot drifts, particularly over short periods of time. However, because

of the gaps in the photographic coverage, the possible spots probably give the most realistic, though not most reliable, picture of the lifetimes and evolution of spots. The bulk of the statistics are computed for the probable spots only.

The second last column of the spot tabulations in the appendix (labelled "PART") lists the identification number for any probable or possible spot of which the tabulated definite or probable spot is a part.

In addition to the data measured directly for each spot, the following characteristics were computed for each definite, probable, and possible spot.

Spot Lifetimes

The observed lifetime of a spot is equal to the last date on which it was observed minus the first date (arbitrarily set equal to 0.5 days for spots observed only once). However, these are clearly minimum lifetimes. From these observed lifetimes and the recorded reasons why the spots were not observed before or after these dates (see Sect. III B), more realistic lifetimes for each spot were computed (when possible) and, in any case, the lifetimes were considered to be in one of six categories of reliability.

Estimated true lifetime: If both ends of a spot lifetime were considered to have been definitely determined (reasons not recorded both coded 0 as described earlier), then an estimate of the true lifetime was made by averaging the observed lifetime and the time difference between the two dates on which the spot was definitely not extant (the latter dates are recorded when ends of spot lifetimes were observed).

Probable lifetime: If one end of a spot lifetime was definitely observed (0), but the other was only probably observed (1), or the spot changed its appearance drastically but did not necessarily disappear (8), the observed lifetime was taken as the spot's probable lifetime.

Twice probable half-lifetime: If one end of a spot life-time was definitely observed (0), but the spot history extended beyond the period covered by the charts (9), a probable but by no means conclusive estimate of the lifetime is twice the observed lifetime. Relatively few spots with lifetimes of many years would disappear or form during the short period under observation. Most spots disappearing during the observed period probably had lives comparable to the period, especially since there was not a large population of spots which survived the entire observed period.

Possible lifetime: If no definite end of a spot history was observed, but the observed ends were for reasons 1 (probable disappearance) or 8 (changed appearance), the observed lifetime was considered a possible estimate of the lifetime.

Twice possible half-lifetime: If one half of the spot history extended outside the observed period and the other end was either probably observed (1) or due to changed appearance (8), twice the observed lifetime was considered a possible estimate of the lifetime.

Minimum lifetime: All other combinations of reasons why spots were not traced either before or after their observed duration yield no meaningful information concerning the true lifetime. If the spot history spanned the entire period of observation (both reasons 9), we can only say that its

observed history was a minimum lifetime for the spot -- the spot could even have been permanent, such as the Red Spot. If the spot was lost due to gaps in the photographic coverage, ambiguity due to crowded adjacent spots and rapid motions, or any of the other reasons coded 2 through 7, there is no reliable information on more than the minimum lifetime of the spot. Unfortunately, most spot lifetimes computed in this study are of this type. The only solution for clarifying information on the lifetimes of many of the smaller spots is to obtain improved photographic resolution and -- more importantly -- coverage.

One and only one kind of lifetime was computed for each spot. These are listed in the tabulations in the appendix in the order described here. Asterisks fill the columns for the lifetimes not applicable to the spot. The following column, labeled "WHY" gives the reasons why the spot could not be followed prior to and after its observed period.

Spot Motions

It is customary to record spot motions in terms of longitudinal drifts relative to the adopted longitude system in 30 days. If the 30-day drift of a spot is called D, and the adopted longitude system rotates with a period P_o (minutes), then the rotation period of the spot is given by

$$P = P_o + \frac{(D)(P_o)^2}{15552000} \quad . \qquad (1)$$

Both the mean 30-day drift, computed between the observed longitudes on the first and last days on which the spot was seen, and the rotation period are listed for each spot in the tabulations in the appendix.

The longitude at opposition, given in the fourth column of the tabulations, is computed from the mean drift for each spot and is not the true longitude of the spot on date of opposition (day number 80) when many of the spots were not even extant.

For those spots lasting long enough to have measured positions at the ends of the six thirty-day intervals, separate 30-day drifts were computed for each interval. To provide a measure of the long-term deviation from uniform motion of the longer-lived spots, the average deviation from the mean of these thirty-day drifts ("30DEV") was computed for each spot observed during at least two of the periods. To provide some information on systematic changes in motion, the mean drifts during the first, second, and last third of the observed part of the apparition were computed for each long-lived spot extant during those periods (these are called "DRIFT1", "DRIFT2", and "DRIFT3" in the tabulations). In order to trace spots across the gap in coverage caused by solar conjunction, the projected positions of spots on November 1, 1967, were computed for all spots lost in June due to the end of coverage (these longitudes are not tabulated here). Comparison of these longitudes with the spots observed in November 1967, when combined with knowledge of typical variations in spot motions computed here, help to identify some larger spots with some assurance, even after a gap of four months.

Spot Lengths

The maximum and minimum lengths measured for each spot yield not only the mean length for each spot, but also a crude estimate of the typical deviation in length for the spot. Tabulated in the column labelled

"DL/L" is the quantity

$$DL/L = \frac{(\lambda_{max} - \lambda_{min})/2}{(\lambda_{max} + \lambda_{min})/2} \quad . \qquad (2)$$

Since the accuracy in measuring the lengths of most spots, particularly the fuzzy ones, is no better than a degree or two, the quantity DL/L is not really representative of physical changes in sizes of spots less than about half a dozen degrees in length. Future investigations of the spots will take such errors into account quantitatively.

B. Characteristics of Currents

The mean 30-day drifts for spots in each current were computed in two ways, neither of which is exactly identical to the procedures used in reductions of visual CM transits. First tabulated is the mean drift for all spots (except those observed only once), weighted by the number of observations of the spots. The weighting reduces the scatter caused by the unreliable drifts of very short-lived spots, but gives perhaps undue weight to the prominent and long-lived spots. More comparable to the mean drifts calculated by amateur astronomers are unweighted averages of the mean drifts of all spots with observed lifetimes of 10 days or more. For both types of calculation of mean current drifts, the average deviation of the individual spots from the current mean is also tabulated.

Both weighted and unweighted mean drifts (and average deviations) were also computed for dark spots, light spots, long spots (length over $7^{\circ}.5$), and short spots (less than $7^{\circ}.5$) in each current separately.

All of the above computations were made separately for three groups of spots: the definite spots, the definite and probable spots, and the definite-probable-possible spots.

Just the definite-probable sample of spots was used for calculating additional mean characteristics for each current. These include the following: the mean of the long-term deviations of the six 30-day drifts from the spots' mean drifts; the mean of the typical short-term deviations in degrees from the spots' mean drifts during 30-day intervals; the mean drift of all of the longer-lived spots in the current during the first, second, and last thirds of the apparition; the mean lifetime of those spots for which either definite or probable lifetimes were computed (the first four of the six lifetime categories); the mean proportion of spots in the current; the mean length of spots; and the mean DL/L length-deviation ratio of spots. Also presented are tables showing the distribution of spots by type and the size-frequency relationship for spots in each current. The numbers tabulated in each interval of length are the sums of the observed lifetimes of spots of that size; this yields a good approximation to the size distribution one might expect to see at any particular instant in time.

C. Relationships between Spot Characteristics

In order to test for any possible relationship between the size, shape, motion, color, or lifetimes of spots, all observed spots (without regard to current) were subdivided according to each characteristic and the means of the other characteristics were computed.

The mean characteristics which were computed were: the mean of the long-term deviations from the individual 30-day drifts; the mean of the short-term deviations from mean drifts during 30 days; the mean lifetime for those spots having either probable or definite lifetimes computed; the mean proportion; the mean length; the mean ratio of length deviation to length; the mean signed deviation of spot drifts from the means of the currents of which the spots are part; the number of dark and light spots; and the distribution of spots by type.

The populations of spots for which the above characteristics were computed were: dark spots; light spots; spots less than 5° in length; spots elongated by a ratio near or exceeding 3; spots longitudinally elongated by a factor of about 2; approximately round spots; spots with latitudinal extents exceeding longitudinal lengths by a factor of about 2; spots with latitudinal elongations near or over a factor of 3; spots drifting at least 3° per 30 days faster than the mean of their currents; spots moving similar to their currents; and spots moving at least 3° per 30 days slower than their currents.

D. Size-Lifetime Relationships

The preliminary numerical results of the size-lifetime relationship under study by R. Hide and the present author (for lifetimes measured in months or less), are presented in the final tables in the appendix. Since it is uncertain whether spot lengths, or their total dimensions may be the physically most-meaningful parameter, the lifetimes are tabulated both in relationship to the mean length and to the mean area, where spot

area (in square degrees) was computed approximately from the crude proportion estimates. The mean of each of the six lifetimes is entered for seven sub-divisions by length or area. Asterisks indicate no spots in a particular category. It can be seen from the tables that it is relatively difficult to obtain reliable lifetimes for the smaller spots and that their frequently shorter observed lifetimes are really just minimum lifetimes interrupted by gaps in good quality photographic coverage.

V. SUMMARY OF CONCLUSIONS

The empirical approaches described earlier have been applied, as a start, to all observed spots in the northern hemisphere of Jupiter (excluding the equatorial jet). The results, presented in the appendices, are largely self-explanatory and require little amplification here. I will, however, summarize some of the more obvious conclusions, after this word of caution: In assessing the significance of the differences in characteristics between groups of spots, it is important to take into account the sizes of the spot data samples being compared. These numbers are printed out explicitly only in Appendix C; however the complete tabulations in Appendix B provide the same information.

The comparisons of the spot populations of the three zonal

regions containing statistically significant numbers of spots, the NEBZ, NTB, and NEBn, reveal certain important differences. For instance, while the drifts of the individual spots in the NEBn generally vary from the mean drift for the current by only a few seconds, there is a substantially larger deviation in the NEBZ. This is, perhaps, to be expected since the NEBZ is the location of the strong latitudinal shear between the equatorial jet and the higher latitudes. Also, for the NEBZ and NTB, both dark spots and smaller spots seem to rotate more rapidly than light spots and larger spots. This may reflect some real variability of motion with color, but it is also possible that it simply reflects a small-scale variation in drift velocity with latitude since white spots and dark spots (for instance) in any given region do not necessarily average to the precise same latitude.

The size-frequency tables are similar for the three regions in showing a peak frequency near 5 km. This may represent a true preferred size for eddies on Jupiter, but more likely this simply reflects the setting in of incompleteness in the tabulations of the less-well-defined spots smaller than 5° due to resolution limitations of the photographs. The incremental population index of the spot size distribution is about -3 in the range 5 to 20 degrees; -3 is a dimensionally significant population index and should be compared with other meteorological scale distributions.

The mean sizes and mean proportions of the spots are similar in the three regions; however, the distributions of spots by type show significant differences.

The sorting of spots in all latitudes into different groupings,

presented in Appendix C, demonstrates surprisingly few strong correlations between spot characteristics. Among the relationships which do seem significant are the tendency for dark spots to be rounder in comparison to more longitudinally-extended light spots, and the tendency for shorter spots to be rounder than the more longitudinally elongated longer spots. This last correlation may be expressed as a tendency for spots to be of relatively constant latitudinal width despite the longitudinal extension -- undoubtedly due to the strong zonality of Jupiter's atmosphere imposed by the planet's rapid rotation. Note also that longer spots tend to vary in length during their lifetimes more than do the shorter ones.

The results on the lifetimes of spots are, unfortunately, relatively inconclusive in this preliminary reduction of the charts. The size-lifetime tables show little relationship between those parameters. Appendix A would seem to suggest that the lifetimes of spots in the NEBZ (the region of strong shear) are less than in the other regions, as one might expect, but observational bias renders the fact uncertain. As the column labelled "WHY" in the spot tabulations indicates, the general complexity of the NEBZ and the highly variable rates of drift in that region, render difficult the reliable determination of lifetimes; these uncertainties would bias against reliable determinations particularly of long lifetimes. Even for the relatively predictable NEBn, about half of the spots have completely undetermined true lifetimes. Further consideration of the problems of determining spot lifetimes from the patrol photographs is in progress.

Preliminary comparison of the spot tabulations with the reduction of amateur astronomers' data for the same period (Budine, 1968), reveals many disagreements. Consideration of the reasons for these disagreements

would be a fruitful direction for further research, especially since comprehensive reductions of the photographic patrol plates such as this one are not being planned on a regular basis and the amateur reductions will be the only published information on Jupiter's spots for some years to come.

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VIII. APPENDICES

These appendices contain tables printed out by the computer and comprise the quantitative results of the present study. The tables are not numbered but come in 4 parts.

(A.) The first appendix lists the characteristics of the spot populations in each of the currents studied. The tabulations are self-explanatory and are described in Section IV-B.

(B.) The second appendix comprises the tabulations, by current, of all the individual spots measured or generated as probable or possible conglomerates. The columns are as follows. First page: (1) Spot reference number; (2) Limiting day numbers on which spot was observed (Nov.2, 1966 = day 1); (3) Projected longitude on date of opposition (day 80); (4) Number of observations of the spot; (5) Mean 30-day drift (degrees); (6) Rotation period; (7) Dark = 1, light = 2; (8) Fuzzy = 1, medium = 2, sharp = 3; (9) Spot proportions, 1 = long, 3 = round, 5 = tall, 0 = border; (10) Spot type: 0 = round or oval, 1 = festoon, 2 = wave or projection, 3 = angular, 4 = amorphous, 5 = variable shape, 6 = preceding border, 7 = following border; (11) Length in degrees; (12) Ratio of deviation in length to length; (13) Short-term deviation in drift (degrees). Second page: (1) Spot reference number; (2-4) 30-day drifts during 1st, 2nd, and last thirds of period; (5) Mean deviation of succesive 30-day drifts; (6) Lifetimes; (7) Reasons why spot not followed before or after observed period (see Sect. III-B); (8) Days when particularly prominent.

(C.) The third appendix lists the mean characteristics of 12 sub-divisions of all the spots. These tabulations are also self-explanatory.

(D.) The last appendix is short and is a tabulation of the lifetime-length and lifetime-area relationship, as described in Sect. IV-D.

Note: In these appendices, asterisks are used in place of blanks. These usually indicate that there were no computed numbers in the particular category, usually because of no data. Several cases probably exist where numbers are omitted because of computational errors; the computer was programmed to store numbers larger than permissible by the output format for a variety of situations in which input data inconsistent with the logical flow of the program would otherwise have yielded incorrect results.

APPENDIX A

Characteristics of Currents

Note: As can be seen from the spot tabulations in Appendix B, only three currents (NEBZ, NEBn, NTB) have a sufficiently large population of spots to permit meaningful intercomparisons of the mean characteristics given in Appendix A.

THE NEBZ CURRENT

FOR DEFINITE SPOTS

MEAN 30-DAY DRIFT, ALL SPOTS, WEIGHTED BY NO. OF OBSERVATIONS = -31.1 AV. DEV= 22.22
MEAN DRIFT, ALL SPOTS (OBSVD LIVES 10 DAYS OR MORE), UNWEIGHTED = -19.0 AV. DEV= 9.26
MEAN DRIFT, DARK SPOTS (OVER 10 DAYS), UNWEIGHTED -30.1 AV. DEV= 19.21
MEAN DRIFT, LIGHT SPOTS (OVER 10 DAYS), UNWEIGHTED = -14.8 AV. DEV= 5.06
MEAN DRIFT, SMALL SPOTS (UNWEIGHTED) = -20.8 AV. DEV= 11.85
MEAN DRIFT, LARGE SPOTS (UNWEIGHTED) = -12.0 AV. DEV= 5.58
MEAN DRIFT, DARK SPOTS (WEIGHTED)= -37.4 AV. DEV= 21.28
MEAN DRIFT, LIGHT SPOTS (WEIGHTED) = -29.4 AV. DEV= 22.00
MEAN DRIFT, SMALL SPOTS (WEIGHTED) = -34.9 AV. DEV= 25.93
MEAN DRIFT, LARGE SPOTS (WEIGHTED) = -21.2 AV. DEV= 9.08

FOR DEFINITE AND PROBABLE SPOTS

MEAN 30-DAY DRIFT, ALL SPOTS, WEIGHTED BY NO. OF OBSERVATIONS = -32.1 AV. DEV= 22.37
MEAN DRIFT, ALL SPOTS (OBSVD LIVES 10 DAYS OR MORE), UNWEIGHTED = -26.7 AV. DEV= 16.38
MEAN DRIFT, DARK SPOTS (OVER 10 DAYS), UNWEIGHTED -44.6 AV. DEV= 30.22
MEAN DRIFT, LIGHT SPOTS (OVER 10 DAYS), UNWEIGHTED = -16.7 AV. DEV= 3.30
MEAN DRIFT, SMALL SPOTS (UNWEIGHTED) = -21.4 AV. DEV= 10.25
MEAN DRIFT, LARGE SPOTS (UNWEIGHTED) = -14.7 AV. DEV= 2.88
MEAN DRIFT, DARK SPOTS (WEIGHTED)= -42.3 AV. DEV= 23.70
MEAN DRIFT, LIGHT SPOTS (WEIGHTED) = -29.0 AV. DEV= 20.87
MEAN DRIFT, SMALL SPOTS (WEIGHTED) = -33.6 AV. DEV= 23.92
MEAN DRIFT, LARGE SPOTS (WEIGHTED) = -21.5 AV. DEV= 9.02

FOR DEFINITE, PROBABLE, AND POSSIBLE SPOTS

MEAN 30-DAY DRIFT, ALL SPOTS, WEIGHTED BY NO. OF OBSERVATIONS = -32.9 AV. DEV= 23.19
MEAN DRIFT, ALL SPOTS (OBSVD LIVES 10 DAYS OR MORE), UNWEIGHTED = -30.4 AV. DEV= 19.79
MEAN DRIFT, DARK SPOTS (OVER 10 DAYS), UNWEIGHTED -47.4 AV. DEV= 28.02
MEAN DRIFT, LIGHT SPOTS (OVER 10 DAYS), UNWEIGHTED = -21.2 AV. DEV= 9.34
MEAN DRIFT, SMALL SPOTS (UNWEIGHTED) = -24.8 AV. DEV= 13.83
MEAN DRIFT, LARGE SPOTS (UNWEIGHTED) = -31.1 AV. DEV= 21.79
MEAN DRIFT, DARK SPOTS (WEIGHTED)= -44.7 AV. DEV= 24.62
MEAN DRIFT, LIGHT SPOTS (WEIGHTED) = -29.2 AV. DEV= 20.85
MEAN DRIFT, SMALL SPOTS (WEIGHTED) = -34.2 AV. DEV= 24.73
MEAN DRIFT, LARGE SPOTS (WEIGHTED) = -23.5 AV. DEV= 12.07

THE NEBZ CURRENT

FOR DEFINITE AND PROBABLE SPOTS

MEAN OF LONG-TERM DEVIATIONS FROM SPOTS' MEAN DRIFTS= 1.50
MEAN OF TYPICAL SHORT-TERM DEVIATIONS (DEG.) FROM SPOTS' MEAN POSITIONS= *****
MEAN DRIFT, ALL SPOTS, FIRST 3RD OF APPARITION= -14.4
MEAN DRIFT, ALL SPOTS, SECOND 3RD OF APPARITION= ******
MEAN DRIFT, ALL SPOTS, LAST 3RD OF APPARITION= ******
MEAN LIFETIME (DAYS), ALL SPOTS WITH DEFINITE OR PROBABLE LIFETIMES COMPUTED= 34.5
MEAN PROPORTION, ALL SPOTS= 2.3
MEAN LENGTH OF ALL SPOTS= 5.6
MEAN RATIO OF TYPICAL DEVIATIONS IN LENGTH TO LENGTH, ALL SPOTS, (WEIGHTED)= 0.26

DISTRIBUTION OF SPOTS BY LENGTH (DEGREES)

LENGTH=	0- 1	1- 2	2- 3	3- 4	4- 5	5- 6	6- 7	7- 8	8- 9	9-10
N X LIFE=	0.0	0.5	17.5	30.5	49.0	199.0	94.5	1.0	0.5	45.0

LENGTH=	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20
N X LIFE=	0.0	0.5	104.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

LENGTH=	20-21	21-22	22-23	23-24	24-25	25-26	26-27	27-28	28-29	29-**
N X LIFE=	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DISTRIBUTION OF SPOTS BY TYPE

TYPE	OVAL	SLANT	FESTOON	WAVE	ANGULAR	AMORPHOUS	VARIABLE	PREC. END	FOL. END
NUMBER	28		0	2	1	14	2	7	7

THE NEBN CURRENT

FOR DEFINITE SPOTS

MEAN 30-DAY DRIFT, ALL SPOTS, WEIGHTED BY NO. OF OBSERVATIONS = -13.1 AV. DEV= 2.69
MEAN DRIFT, ALL SPOTS (OBSVD LIVES 10 DAYS OR MORE), UNWEIGHTED = -12.3 AV. DEV= 3.49
MEAN DRIFT, DARK SPOTS (OVER 10 DAYS), UNWEIGHTED -11.6 AV. DEV= 3.79
MEAN DRIFT, LIGHT SPOTS (OVER 10 DAYS), UNWEIGHTED = -12.9 AV. DEV= 3.38
MEAN DRIFT, SMALL SPOTS (UNWEIGHTED) = -12.7 AV. DEV= 3.36
MEAN DRIFT, LARGE SPOTS (UNWEIGHTED) = -12.4 AV. DEV= 3.08
MEAN DRIFT, DARK SPOTS (WEIGHTED)= -12.6 AV. DEV= 2.69
MEAN DRIFT, LIGHT SPOTS (WEIGHTED) = -13.3 AV. DEV= 2.72
MEAN DRIFT, SMALL SPOTS (WEIGHTED) = -13.1 AV. DEV= 2.95
MEAN DRIFT, LARGE SPOTS (WEIGHTED) = -13.3 AV. DEV= 1.83

FOR DEFINITE AND PROBABLE SPOTS

MEAN 30-DAY DRIFT, ALL SPOTS, WEIGHTED BY NO. OF OBSERVATIONS = -13.1 AV. DEV= 2.47
MEAN DRIFT, ALL SPOTS (OBSVD LIVES 10 DAYS OR MORE), UNWEIGHTED = -12.5 AV. DEV= 3.27
MEAN DRIFT, DARK SPOTS (OVER 10 DAYS), UNWEIGHTED -11.6 AV. DEV= 3.79
MEAN DRIFT, LIGHT SPOTS (OVER 10 DAYS), UNWEIGHTED = -13.1 AV. DEV= 3.01
MEAN DRIFT, SMALL SPOTS (UNWEIGHTED) = -12.8 AV. DEV= 2.97
MEAN DRIFT, LARGE SPOTS (UNWEIGHTED) = -12.6 AV. DEV= 3.27
MEAN DRIFT, DARK SPOTS (WEIGHTED)= -12.6 AV. DEV= 2.69
MEAN DRIFT, LIGHT SPOTS (WEIGHTED) = -13.3 AV. DEV= 2.35
MEAN DRIFT, SMALL SPOTS (WEIGHTED) = -13.0 AV. DEV= 2.53
MEAN DRIFT, LARGE SPOTS (WEIGHTED) = -13.8 AV. DEV= 1.98

FOR DEFINITE, PROBABLE, AND POSSIBLE SPOTS

MEAN 30-DAY DRIFT, ALL SPOTS, WEIGHTED BY NO. OF OBSERVATIONS = -13.1 AV. DEV= 2.47
MEAN DRIFT, ALL SPOTS (OBSVD LIVES 10 DAYS OR MORE), UNWEIGHTED = -12.5 AV. DEV= 3.27
MEAN DRIFT, DARK SPOTS (OVER 10 DAYS), UNWEIGHTED -11.6 AV. DEV= 3.79
MEAN DRIFT, LIGHT SPOTS (OVER 10 DAYS), UNWEIGHTED = -13.1 AV. DEV= 3.01
MEAN DRIFT, SMALL SPOTS (UNWEIGHTED) = -12.8 AV. DEV= 2.97
MEAN DRIFT, LARGE SPOTS (UNWEIGHTED) = -12.6 AV. DEV= 3.27
MEAN DRIFT, DARK SPOTS (WEIGHTED)= -12.6 AV. DEV= 2.69
MEAN DRIFT, LIGHT SPOTS (WEIGHTED) = -13.3 AV. DEV= 2.35
MEAN DRIFT, SMALL SPOTS (WEIGHTED) = -13.0 AV. DEV= 2.53
MEAN DRIFT, LARGE SPOTS (WEIGHTED) = -13.8 AV. DEV= 1.98

THE NEBN CURRENT

FOR DEFINITE AND PROBABLE SPOTS

MEAN OF LONG-TERM DEVIATIONS FROM SPOTS' MEAN DRIFTS= 1.97
MEAN OF TYPICAL SHORT-TERM DEVIATIONS (DEG.) FROM SPOTS' MEAN POSITIONS= 2.00
MEAN DRIFT, ALL SPOTS, FIRST 3RD OF APPARITION= -14.2
MEAN DRIFT, ALL SPOTS, SECOND 3RD OF APPARITION= -13.8
MEAN DRIFT, ALL SPOTS, LAST 3RD OF APPARITION= ******
MEAN LIFETIME (DAYS), ALL SPOTS WITH DEFINITE OR PROBABLE LIFETIMES COMPUTED= 123.4
MEAN PROPORTION, ALL SPOTS= 2.4
MEAN LENGTH OF ALL SPOTS= 5.3
MEAN RATIO OF TYPICAL DEVIATIONS IN LENGTH TO LENGTH, ALL SPOTS, (WEIGHTED)= 0.28

DISTRIBUTION OF SPOTS BY LENGTH (DEGREES)

LENGTH=	0- 1	1- 2	2- 3	3- 4	4- 5	5- 6	6- 7	7- 8	8- 9	9-10
N X LIFE=	0.0	0.5	137.0	644.5	435.0	207.0	432.0	268.0	36.0	41.0
LENGTH=	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20
N X LIFE=	99.0	133.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LENGTH=	20-21	21-22	22-23	23-24	24-25	25-26	26-27	27-28	28-29	29-**
N X LIFE=	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DISTRIBUTION OF SPOTS BY TYPE

TYPE	OVAL	SLANT	FESTOON	WAVE	ANGULAR	AMORPHOUS	VARIABLE	PREC. END	FOL. END
NUMBER	21		0	2	1	11	0	7	7

THE NTRZ CURRENT

FOR DEFINITE SPOTS

MEAN 30-DAY DRIFT, ALL SPOTS, WEIGHTED BY NO. OF OBSERVATIONS = -14.3 AV. DEV= 3.87
MEAN DRIFT, ALL SPOTS (OBSVD LIVES 10 DAYS OR MORE), UNWEIGHTED = -11.7 AV. DEV= 0.0
MEAN DRIFT, DARK SPOTS (OVER 10 DAYS), UNWEIGHTED ****** AV. DEV= *****
MEAN DRIFT, LIGHT SPOTS (OVER 10 DAYS), UNWEIGHTED = -11.7 AV. DEV= 0.0
MEAN DRIFT, SMALL SPOTS (UNWEIGHTED) = ****** AV. DEV= *****
MEAN DRIFT, LARGE SPOTS (UNWEIGHTED) = -11.7 AV. DEV= 0.0
MEAN DRIFT, DARK SPOTS (WEIGHTED)= ****** AV. DEV= *****
MEAN DRIFT, LIGHT SPOTS (WEIGHTED) = -14.3 AV. DEV= 3.87
MEAN DRIFT, SMALL SPOTS (WEIGHTED) = -21.4 AV. DEV= 0.0
MEAN DRIFT, LARGE SPOTS (WEIGHTED) = -11.7 AV. DEV= 0.0

FOR DEFINITE AND PROBABLE SPOTS

MEAN 30-DAY DRIFT, ALL SPOTS, WEIGHTED BY NO. OF OBSERVATIONS = -12.8 AV. DEV= 1.48
MEAN DRIFT, ALL SPOTS (OBSVD LIVES 10 DAYS OR MORE), UNWEIGHTED = -13.3 AV. DEV= 1.67
MEAN DRIFT, DARK SPOTS (OVER 10 DAYS), UNWEIGHTED ****** AV. DEV= *****
MEAN DRIFT, LIGHT SPOTS (OVER 10 DAYS), UNWEIGHTED = -13.3 AV. DEV= 1.67
MEAN DRIFT, SMALL SPOTS (UNWEIGHTED) = -15.0 AV. DEV= 0.0
MEAN DRIFT, LARGE SPOTS (UNWEIGHTED) = -11.7 AV. DEV= 0.0
MEAN DRIFT, DARK SPOTS (WEIGHTED)= ****** AV. DEV= *****
MEAN DRIFT, LIGHT SPOTS (WEIGHTED) = -12.8 AV. DEV= 1.48
MEAN DRIFT, SMALL SPOTS (WEIGHTED) = -15.0 AV. DEV= 0.0
MEAN DRIFT, LARGE SPOTS (WEIGHTED) = -11.7 AV. DEV= 0.0

FOR DEFINITE, PROBABLE, AND POSSIBLE SPOTS

MEAN 30-DAY DRIFT, ALL SPOTS, WEIGHTED BY NO. OF OBSERVATIONS = -12.8 AV. DEV= 1.48
MEAN DRIFT, ALL SPOTS (OBSVD LIVES 10 DAYS OR MORE), UNWEIGHTED = -13.3 AV. DEV= 1.67
MEAN DRIFT, DARK SPOTS (OVER 10 DAYS), UNWEIGHTED ****** AV. DEV= *****
MEAN DRIFT, LIGHT SPOTS (OVER 10 DAYS), UNWEIGHTED = -13.3 AV. DEV= 1.67
MEAN DRIFT, SMALL SPOTS (UNWEIGHTED) = -15.0 AV. DEV= 0.0
MEAN DRIFT, LARGE SPOTS (UNWEIGHTED) = -11.7 AV. DEV= 0.0
MEAN DRIFT, DARK SPOTS (WEIGHTED)= ****** AV. DEV= *****
MEAN DRIFT, LIGHT SPOTS (WEIGHTED) = -12.8 AV. DEV= 1.48
MEAN DRIFT, SMALL SPOTS (WEIGHTED) = -15.0 AV. DEV= 0.0
MEAN DRIFT, LARGE SPOTS (WEIGHTED) = -11.7 AV. DEV= 0.0

THE NTRZ CURRENT

FOR DEFINITE AND PROBABLE SPOTS

MEAN OF LONG-TERM DEVIATIONS FROM SPOTS' MEAN DRIFTS= *****
MEAN OF TYPICAL SHORT-TERM DEVIATIONS (DEG.) FROM SPOTS' MEAN POSITIONS= *****
MEAN DRIFT, ALL SPOTS, FIRST 3RD OF APPARITION= ******
MEAN DRIFT, ALL SPOTS, SECOND 3RD OF APPARITION= ******
MEAN DRIFT, ALL SPOTS, LAST 3RD OF APPARITION= ******
MEAN LIFETIME (DAYS), ALL SPOTS WITH DEFINITE OR PROBABLE LIFETIMES COMPUTED= *****
MEAN PROPORTION, ALL SPOTS= 2.4
MEAN LENGTH OF ALL SPOTS= 5.1
MEAN RATIO OF TYPICAL DEVIATIONS IN LENGTH TO LENGTH, ALL SPOTS, (WEIGHTED)= 0.08

DISTRIBUTION OF SPOTS BY LENGTH (DEGREES)

LENGTH=	0- 1	1- 2	2- 3	3- 4	4- 5	5- 6	6- 7	7- 8	8- 9	9-10
N X LIFE=	0.0	1.0	0.0	0.5	0.5	14.5	0.0	0.0	0.0	0.0
LENGTH=	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20
N X LIFE=	18.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LENGTH=	20-21	21-22	22-23	23-24	24-25	25-26	26-27	27-28	28-29	29-**
N X LIFE=	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DISTRIBUTION OF SPOTS BY TYPE

TYPE	OVAL	SLANT	FESTOON	WAVE	ANGULAR	AMORPHOUS	VARIABLE	PREC. END	FOL. END
NUMBER	5	2		4	0	1	0	7	7

THE NTBS CURRENT

FOR DEFINITE SPOTS

MEAN 30-DAY DRIFT, ALL SPOTS, WEIGHTED BY NO. OF OBSERVATIONS = 32.7 AV. DEV= 0.0
MEAN DRIFT, ALL SPOTS (OBSVD LIVES 10 DAYS OR MORE), UNWEIGHTED = 32.7 AV. DEV= 0.0
MEAN DRIFT, DARK SPOTS (OVER 10 DAYS), UNWEIGHTED ****** AV. DEV= *****
MEAN DRIFT, LIGHT SPOTS (OVER 10 DAYS), UNWEIGHTED = 32.7 AV. DEV= 0.0
MEAN DRIFT, SMALL SPOTS (UNWEIGHTED) = 32.7 AV. DEV= 0.0
MEAN DRIFT, LARGE SPOTS (UNWEIGHTED) = ****** AV. DEV= *****
MEAN DRIFT, DARK SPOTS (WEIGHTED)= ****** AV. DEV= *****
MEAN DRIFT, LIGHT SPOTS (WEIGHTED) = 32.7 AV. DEV= 0.0
MEAN DRIFT, SMALL SPOTS (WEIGHTED) = 32.7 AV. DEV= 0.0
MEAN DRIFT, LARGE SPOTS (WEIGHTED) = ****** AV. DEV= *****

FOR DEFINITE AND PROBABLE SPOTS

MEAN 30-DAY DRIFT, ALL SPOTS, WEIGHTED BY NO. OF OBSERVATIONS = 32.7 AV. DEV= 0.0
MEAN DRIFT, ALL SPOTS (OBSVD LIVES 10 DAYS OR MORE), UNWEIGHTED = 32.7 AV. DEV= 0.0
MEAN DRIFT, DARK SPOTS (OVER 10 DAYS), UNWEIGHTED ****** AV. DEV= *****
MEAN DRIFT, LIGHT SPOTS (OVER 10 DAYS), UNWEIGHTED = 32.7 AV. DEV= 0.0
MEAN DRIFT, SMALL SPOTS (UNWEIGHTED) = 32.7 AV. DEV= 0.0
MEAN DRIFT, LARGE SPOTS (UNWEIGHTED) = ****** AV. DEV= *****
MEAN DRIFT, DARK SPOTS (WEIGHTED)= ****** AV. DEV= *****
MEAN DRIFT, LIGHT SPOTS (WEIGHTED) = 32.7 AV. DEV= 0.0
MEAN DRIFT, SMALL SPOTS (WEIGHTED) = 32.7 AV. DEV= 0.0
MEAN DRIFT, LARGE SPOTS (WEIGHTED) = ****** AV. DEV= *****

FOR DEFINITE, PROBABLE, AND POSSIBLE SPOTS

MEAN 30-DAY DRIFT, ALL SPOTS, WEIGHTED BY NO. OF OBSERVATIONS = 32.7 AV. DEV= 0.0
MEAN DRIFT, ALL SPOTS (OBSVD LIVES 10 DAYS OR MORE), UNWEIGHTED = 32.7 AV. DEV= 0.0
MEAN DRIFT, DARK SPOTS (OVER 10 DAYS), UNWEIGHTED ****** AV. DEV= *****
MEAN DRIFT, LIGHT SPOTS (OVER 10 DAYS), UNWEIGHTED = 32.7 AV. DEV= 0.0
MEAN DRIFT, SMALL SPOTS (UNWEIGHTED) = 32.7 AV. DEV= 0.0
MEAN DRIFT, LARGE SPOTS (UNWEIGHTED) = ****** AV. DEV= *****
MEAN DRIFT, DARK SPOTS (WEIGHTED)= ****** AV. DEV= *****
MEAN DRIFT, LIGHT SPOTS (WEIGHTED) = 32.7 AV. DEV= 0.0
MEAN DRIFT, SMALL SPOTS (WEIGHTED) = 32.7 AV. DEV= 0.0
MEAN DRIFT, LARGE SPOTS (WEIGHTED) = ****** AV. DEV= *****

THE NTBS CURRENT

FOR DEFINITE AND PROBABLE SPOTS

MEAN OF LONG-TERM DEVIATIONS FROM SPOTS' MEAN DRIFTS= *****
MEAN OF TYPICAL SHORT-TERM DEVIATIONS (DEG.) FROM SPOTS' MEAN POSITIONS= *****
MEAN DRIFT, ALL SPOTS, FIRST 3RD OF APPARITION= ******
MEAN DRIFT, ALL SPOTS, SECOND 3RD OF APPARITION= ******
MEAN DRIFT, ALL SPOTS, LAST 3RD OF APPARITION= ******
MEAN LIFETIME (DAYS), ALL SPOTS WITH DEFINITE OR PROBABLE LIFETIMES COMPUTED= *****
MEAN PROPORTION, ALL SPOTS= 1.0
MEAN LENGTH OF ALL SPOTS= 6.0
MEAN RATIO OF TYPICAL DEVIATIONS IN LENGTH TO LENGTH, ALL SPOTS, (WEIGHTED)= 0.17

DISTRIBUTION OF SPOTS BY LENGTH (DEGREES)

LENGTH=	0- 1	1- 2	2- 3	3- 4	4- 5	5- 6	6- 7	7- 8	8- 9	9-10
N X LIFE=	0.0	0.0	0.0	0.0	0.0	22.0	0.0	0.0	0.0	0.0
LENGTH=	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20
N X LIFE=	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LENGTH=	20-21	21-22	22-23	23-24	24-25	25-26	26-27	27-28	28-29	29-**
N X LIFE=	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DISTRIBUTION OF SPOTS BY TYPE

TYPE	OVAL	SLANT	FESTOON	WAVE	ANGULAR	AMORPHOUS	VARIABLE	PREC. END	FOL. END
NUMBER	2	0		2	0	1	1	7	7

THE NTB CURRENT

FOR DEFINITE SPOTS

MEAN 30-DAY DRIFT, ALL SPOTS, WEIGHTED BY NO. OF OBSERVATIONS = 18.0 AV. DEV= 10.10
MEAN DRIFT, ALL SPOTS (OBSVD LIVES 10 DAYS OR MORE), UNWEIGHTED = 21.2 AV. DEV= 6.74
MEAN DRIFT, DARK SPOTS (OVER 10 DAYS), UNWEIGHTED 20.6 AV. DEV= 8.22
MEAN DRIFT, LIGHT SPOTS (OVER 10 DAYS), UNWEIGHTED = 23.1 AV. DEV= 2.62
MEAN DRIFT, SMALL SPOTS (UNWEIGHTED) = 20.8 AV. DEV= 6.93
MEAN DRIFT, LARGE SPOTS (UNWEIGHTED) = 22.3 AV. DEV= 5.82
MEAN DRIFT, DARK SPOTS (WEIGHTED) = 16.6 AV. DEV= 11.24
MEAN DRIFT, LIGHT SPOTS (WEIGHTED) = 23.4 AV. DEV= 3.74
MEAN DRIFT, SMALL SPOTS (WEIGHTED) = 17.6 AV. DEV= 11.21
MEAN DRIFT, LARGE SPOTS (WEIGHTED) = 19.9 AV. DEV= 7.26

FOR DEFINITE AND PROBABLE SPOTS

MEAN 30-DAY DRIFT, ALL SPOTS, WEIGHTED BY NO. OF OBSERVATIONS = 18.1 AV. DEV= 10.04
MEAN DRIFT, ALL SPOTS (OBSVD LIVES 10 DAYS OR MORE), UNWEIGHTED = 21.1 AV. DEV= 6.84
MEAN DRIFT, DARK SPOTS (OVER 10 DAYS), UNWEIGHTED 20.3 AV. DEV= 8.33
MEAN DRIFT, LIGHT SPOTS (OVER 10 DAYS), UNWEIGHTED = 23.4 AV. DEV= 2.48
MEAN DRIFT, SMALL SPOTS (UNWEIGHTED) = 20.5 AV. DEV= 7.23
MEAN DRIFT, LARGE SPOTS (UNWEIGHTED) = 22.1 AV. DEV= 5.85
MEAN DRIFT, DARK SPOTS (WEIGHTED) = 16.7 AV. DEV= 11.30
MEAN DRIFT, LIGHT SPOTS (WEIGHTED) = 23.4 AV. DEV= 3.52
MEAN DRIFT, SMALL SPOTS (WEIGHTED) = 17.0 AV. DEV= 11.79
MEAN DRIFT, LARGE SPOTS (WEIGHTED) = 19.7 AV. DEV= 7.38

FOR DEFINITE, PROBABLE, AND POSSIBLE SPOTS

MEAN 30-DAY DRIFT, ALL SPOTS, WEIGHTED BY NO. OF OBSERVATIONS = 18.1 AV. DEV= 10.05
MEAN DRIFT, ALL SPOTS (OBSVD LIVES 10 DAYS OR MORE), UNWEIGHTED = 21.2 AV. DEV= 6.73
MEAN DRIFT, DARK SPOTS (OVER 10 DAYS), UNWEIGHTED 20.4 AV. DEV= 8.19
MEAN DRIFT, LIGHT SPOTS (OVER 10 DAYS), UNWEIGHTED = 23.4 AV. DEV= 2.48
MEAN DRIFT, SMALL SPOTS (UNWEIGHTED) = 20.5 AV. DEV= 7.23
MEAN DRIFT, LARGE SPOTS (UNWEIGHTED) = 22.3 AV. DEV= 5.62
MEAN DRIFT, DARK SPOTS (WEIGHTED) = 16.7 AV. DEV= 11.29
MEAN DRIFT, LIGHT SPOTS (WEIGHTED) = 23.4 AV. DEV= 3.52
MEAN DRIFT, SMALL SPOTS (WEIGHTED) = 17.0 AV. DEV= 11.79
MEAN DRIFT, LARGE SPOTS (WEIGHTED) = 19.6 AV. DEV= 7.50

THE NTB CURRENT

FOR DEFINITE AND PROBABLE SPOTS

MEAN OF LONG-TERM DEVIATIONS FROM SPOTS' MEAN DRIFTS= 2.23
MEAN OF TYPICAL SHORT-TERM DEVIATIONS (DEG.) FROM SPOTS' MEAN POSITIONS= *****
MEAN DRIFT, ALL SPOTS, FIRST 3RD OF APPARITION= 16.3
MEAN DRIFT, ALL SPOTS, SECOND 3RD OF APPARITION= 22.6
MEAN DRIFT, ALL SPOTS, LAST 3RD OF APPARITION= ******
MEAN LIFETIME (DAYS), ALL SPOTS WITH DEFINITE OR PROBABLE LIFETIMES COMPUTED= 88.2
MEAN PROPORTION, ALL SPOTS= 2.2
MEAN LENGTH OF ALL SPOTS= ****
MEAN RATIO OF TYPICAL DEVIATIONS IN LENGTH TO LENGTH, ALL SPOTS, (WEIGHTED)= 0.23

DISTRIBUTION OF SPOTS BY LENGTH (DEGREES)

LENGTH=	0- 1	1- 2	2- 3	3- 4	4- 5	5- 6	6- 7	7- 8	8- 9	9-10
N X LIFE=	0.0	0.0	23.0	63.0	296.5	663.0	395.0	391.0	297.0	58.5
LENGTH=	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20
N X LIFE=	15.0	5.0	59.0	0.0	0.0	0.0	46.0	71.0	0.0	0.0
LENGTH=	20-21	21-22	22-23	23-24	24-25	25-26	26-27	27-28	28-29	29-**
N X LIFE=	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DISTRIBUTION OF SPOTS BY TYPE

TYPE	OVAL	SLANT	FESTOON	WAVE	ANGULAR	AMORPHOUS	VARIABLE	PREC. END	FOL. END
NUMBER	28		0	21	2	19	1	8	7

THE NNTBS CURRENT

FOR DEFINITE SPOTS

MEAN 30-DAY DRIFT, ALL SPOTS, WEIGHTED BY NO. OF OBSERVATIONS = -3.3 AV. DEV= 4.82
MEAN DRIFT, ALL SPOTS (OBSVD LIVES 10 DAYS OR MORE), UNWEIGHTED = -1.2 AV. DEV= 5.76
MEAN DRIFT, DARK SPOTS (OVER 10 DAYS), UNWEIGHTED 0.8 AV. DEV= 6.82
MEAN DRIFT, LIGHT SPOTS (OVER 10 DAYS), UNWEIGHTED = -3.6 AV. DEV= 4.31
MEAN DRIFT, SMALL SPOTS (UNWEIGHTED) = -1.2 AV. DEV= 5.91
MEAN DRIFT, LARGE SPOTS (UNWEIGHTED) = -4.3 AV. DEV= 3.39
MEAN DRIFT, DARK SPOTS (WEIGHTED)= -3.0 AV. DEV= 4.89
MEAN DRIFT, LIGHT SPOTS (WEIGHTED) = -3.8 AV. DEV= 4.36
MEAN DRIFT, SMALL SPOTS (WEIGHTED) = -4.2 AV. DEV= 6.22
MEAN DRIFT, LARGE SPOTS (WEIGHTED) = -3.3 AV. DEV= 2.85

FOR DEFINITE AND PROBABLE SPOTS

MEAN 30-DAY DRIFT, ALL SPOTS, WEIGHTED BY NO. OF OBSERVATIONS = -3.3 AV. DEV= 4.82
MEAN DRIFT, ALL SPOTS (OBSVD LIVES 10 DAYS OR MORE), UNWEIGHTED = -1.2 AV. DEV= 5.76
MEAN DRIFT, DARK SPOTS (OVER 10 DAYS), UNWEIGHTED 0.8 AV. DEV= 6.82
MEAN DRIFT, LIGHT SPOTS (OVER 10 DAYS), UNWEIGHTED = -3.6 AV. DEV= 4.31
MEAN DRIFT, SMALL SPOTS (UNWEIGHTED) = -1.2 AV. DEV= 5.91
MEAN DRIFT, LARGE SPOTS (UNWEIGHTED) = -4.3 AV. DEV= 3.39
MEAN DRIFT, DARK SPOTS (WEIGHTED)= -3.0 AV. DEV= 4.89
MEAN DRIFT, LIGHT SPOTS (WEIGHTED) = -3.8 AV. DEV= 4.36
MEAN DRIFT, SMALL SPOTS (WEIGHTED) = -4.2 AV. DEV= 6.22
MEAN DRIFT, LARGE SPOTS (WEIGHTED) = -3.3 AV. DEV= 2.85

FOR DEFINITE, PROBABLE, AND POSSIBLE SPOTS

MEAN 30-DAY DRIFT, ALL SPOTS, WEIGHTED BY NO. OF OBSERVATIONS = -3.3 AV. DEV= 4.82
MEAN DRIFT, ALL SPOTS (OBSVD LIVES 10 DAYS OR MORE), UNWEIGHTED = -1.2 AV. DEV= 5.76
MEAN DRIFT, DARK SPOTS (OVER 10 DAYS), UNWEIGHTED 0.8 AV. DEV= 6.82
MEAN DRIFT, LIGHT SPOTS (OVER 10 DAYS), UNWEIGHTED = -3.6 AV. DEV= 4.31
MEAN DRIFT, SMALL SPOTS (UNWEIGHTED) = -1.2 AV. DEV= 5.91
MEAN DRIFT, LARGE SPOTS (UNWEIGHTED) = -4.3 AV. DEV= 3.39
MEAN DRIFT, DARK SPOTS (WEIGHTED)= -3.0 AV. DEV= 4.89
MEAN DRIFT, LIGHT SPOTS (WEIGHTED) = -3.8 AV. DEV= 4.36
MEAN DRIFT, SMALL SPOTS (WEIGHTED) = -4.2 AV. DEV= 6.22
MEAN DRIFT, LARGE SPOTS (WEIGHTED) = -3.3 AV. DEV= 2.85

THE NNTBS CURRENT

FOR DEFINITE AND PROBABLE SPOTS

MEAN OF LONG-TERM DEVIATIONS FROM SPOTS' MEAN DRIFTS= 2.06
MEAN OF TYPICAL SHORT-TERM DEVIATIONS (DEG.) FROM SPOTS' MEAN POSITIONS= 3.43
MEAN DRIFT, ALL SPOTS, FIRST 3RD OF APPARITION= -6.6
MEAN DRIFT, ALL SPOTS, SECOND 3RD OF APPARITION= -5.0
MEAN DRIFT, ALL SPOTS, LAST 3RD OF APPARITION= ******
MEAN LIFETIME (DAYS), ALL SPOTS WITH DEFINITE OR PROBABLE LIFETIMES COMPUTED= *****
MEAN PROPORTION, ALL SPOTS= 2.5
MEAN LENGTH OF ALL SPOTS= 6.1
MEAN RATIO OF TYPICAL DEVIATIONS IN LENGTH TO LENGTH, ALL SPOTS, (WEIGHTED)= 0.18

DISTRIBUTION OF SPOTS BY LENGTH (DEGREES)

LENGTH=	0- 1	1- 2	2- 3	3- 4	4- 5	5- 6	6- 7	7- 8	8- 9	9-10
N X LIFE=	0.0	0.0	3.0	46.0	149.0	92.0	57.0	142.0	86.0	0.0
LENGTH=	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20
N X LIFE=	205.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LENGTH=	20-21	21-22	22-23	23-24	24-25	25-26	26-27	27-28	28-29	29-**
N X LIFE=	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DISTRIBUTION OF SPOTS BY TYPE

TYPE	OVAL	SLANT	FESTOON	WAVE	ANGULAR	AMORPHOUS	VARIABLE	PREC. END	FOL. END
NUMBER	12	2		2	0	3	0	7	7

THE NNTEZ CURRENT

FOR DEFINITE SPOTS

MEAN 30-DAY DRIFT, ALL SPOTS, WEIGHTED BY NO. OF OBSERVATIONS = -9.8 AV. DEV= 3.94
MEAN DRIFT, ALL SPOTS (OBSVD LIVES 10 DAYS OR MORE), UNWEIGHTED = -10.3 AV. DEV= 3.62
MEAN DRIFT, DARK SPOTS (OVER 10 DAYS), UNWEIGHTED -7.9 AV. DEV= 1.40
MEAN DRIFT, LIGHT SPOTS (OVER 10 DAYS), UNWEIGHTED = -17.5 AV. DEV= 0.0
MEAN DRIFT, SMALL SPOTS (UNWEIGHTED) = -17.5 AV. DEV= 0.0
MEAN DRIFT, LARGE SPOTS (UNWEIGHTED) = -10.0 AV. DEV= 0.0
MEAN DRIFT, DARK SPOTS (WEIGHTED)= -7.2 AV. DEV= 1.46
MEAN DRIFT, LIGHT SPOTS (WEIGHTED) = -17.5 AV. DEV= 0.0
MEAN DRIFT, SMALL SPOTS (WEIGHTED) = -17.5 AV. DEV= 0.0
MEAN DRIFT, LARGE SPOTS (WEIGHTED) = -10.0 AV. DEV= 0.0

FOR DEFINITE AND PROBABLE SPOTS

MEAN 30-DAY DRIFT, ALL SPOTS, WEIGHTED BY NO. OF OBSERVATIONS = -9.8 AV. DEV= 3.94
MEAN DRIFT, ALL SPOTS (OBSVD LIVES 10 DAYS OR MORE), UNWEIGHTED = -10.3 AV. DEV= 3.62
MEAN DRIFT, DARK SPOTS (OVER 10 DAYS), UNWEIGHTED -7.9 AV. DEV= 1.40
MEAN DRIFT, LIGHT SPOTS (OVER 10 DAYS), UNWEIGHTED = -17.5 AV. DEV= 0.0
MEAN DRIFT, SMALL SPOTS (UNWEIGHTED) = -17.5 AV. DEV= 0.0
MEAN DRIFT, LARGE SPOTS (UNWEIGHTED) = -10.0 AV. DEV= 0.0
MEAN DRIFT, DARK SPOTS (WEIGHTED)= -7.2 AV. DEV= 1.46
MEAN DRIFT, LIGHT SPOTS (WEIGHTED) = -17.5 AV. DEV= 0.0
MEAN DRIFT, SMALL SPOTS (WEIGHTED) = -17.5 AV. DEV= 0.0
MEAN DRIFT, LARGE SPOTS (WEIGHTED) = -10.0 AV. DEV= 0.0

FOR DEFINITE, PROBABLE, AND POSSIBLE SPOTS

MEAN 30-DAY DRIFT, ALL SPOTS, WEIGHTED BY NO. OF OBSERVATIONS = -9.8 AV. DEV= 3.94
MEAN DRIFT, ALL SPOTS (OBSVD LIVES 10 DAYS OR MORE), UNWEIGHTED = -10.3 AV. DEV= 3.62
MEAN DRIFT, DARK SPOTS (OVER 10 DAYS), UNWEIGHTED -7.9 AV. DEV= 1.40
MEAN DRIFT, LIGHT SPOTS (OVER 10 DAYS), UNWEIGHTED = -17.5 AV. DEV= 0.0
MEAN DRIFT, SMALL SPOTS (UNWEIGHTED) = -17.5 AV. DEV= 0.0
MEAN DRIFT, LARGE SPOTS (UNWEIGHTED) = -10.0 AV. DEV= 0.0
MEAN DRIFT, DARK SPOTS (WEIGHTED)= -7.2 AV. DEV= 1.46
MEAN DRIFT, LIGHT SPOTS (WEIGHTED) = -17.5 AV. DEV= 0.0
MEAN DRIFT, SMALL SPOTS (WEIGHTED) = -17.5 AV. DEV= 0.0
MEAN DRIFT, LARGE SPOTS (WEIGHTED) = -10.0 AV. DEV= 0.0

THE NNTEZ CURRENT

FOR DEFINITE AND PROBABLE SPOTS

MEAN OF LONG-TERM DEVIATIONS FROM SPOTS' MEAN DRIFTS= *****
MEAN OF TYPICAL SHORT-TERM DEVIATIONS (DEG.) FROM SPOTS' MEAN POSITIONS= 2.50
MEAN DRIFT, ALL SPOTS, FIRST 3RD OF APPARITION= ******
MEAN DRIFT, ALL SPOTS, SECOND 3RD OF APPARITION= ******
MEAN DRIFT, ALL SPOTS, LAST 3RD OF APPARITION= ******
MEAN LIFETIME (DAYS), ALL SPOTS WITH DEFINITE OR PROBABLE LIFETIMES COMPUTED= *****
MEAN PROPORTION, ALL SPOTS= 2.0
MEAN LENGTH OF ALL SPOTS= 6.5
MEAN RATIO OF TYPICAL DEVIATIONS IN LENGTH TO LENGTH, ALL SPOTS, (WEIGHTED)= 0.05

DISTRIBUTION OF SPOTS BY LENGTH (DEGREES)

LENGTH=	0- 1	1- 2	2- 3	3- 4	4- 5	5- 6	6- 7	7- 8	8- 9	9-10
N X LIFE=	0.0	0.0	0.0	0.0	53.0	0.0	0.0	12.0	0.0	0.0
LENGTH=	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20
N X LIFE=	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LENGTH=	20-21	21-22	22-23	23-24	24-25	25-26	26-27	27-28	28-29	29-**
N X LIFE=	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DISTRIBUTION OF SPOTS BY TYPE

TYPE	OVAL	SLANT	FESTOON	WAVE	ANGULAR	AMORPHOUS	VARIABLE	PREC. END	FOL. END
NUMBER	3		0	2	0	2	0	7	7

APPENDIX B

Tabulations of All Observed Spots

Note: Tabulations for definite-and-probable and for definite-probable-possible spots are omitted in this appendix in those cases when they are identical to the tabulations which would have immediately preceded them (i.e. when there are no additional probable or possible spots).

THE NEBZ CURRENT. NOV 1966-JUNE 1967.

DEFINITE SPOTS

SPOT	DATES	OBSVD	LONG	NO.	DRIFT	ROT PERIOD	D,L	S	P	T	LENGTH	DL/L	DEV
44	81	185	42.	27	-17.6	9H55M16.5S	2	2	1	0	12.5	0.36	3
45	89	91	121.	3	-165.0	9H51M54.7S	2	2	3	0	5.0	0.0	**
46	89	90	129.	?	-150.0	9H52M15.3S	2	2	2	0	4.0	0.0	**
47	103	104	141.	?	-60.0	9H54M18.5S	1	1	3	4	7.0	0.0	**
48	103	104	135.	?	-30.0	9H54M59.5S	1	2	4	4	4.0	0.0	**
49	103	104	122.	2	0.0	9H55M40.6S	1	3	4	1	2.0	0.0	**
50	113	113	****	1	******	*H**M****S	1	1	3	4	3.0	0.0	**
51	121	121	****	1	******	*H**M****S	1	2	3	4	4.0	0.0	**
52	128	130	148.	?	-30.0	9H54M59.5S	1	2	3	4	3.0	0.0	**
53	126	130	104.	3	7.5	9H55M50.9S	2	2	3	0	3.0	0.33	**
54	121	128	180.	3	-34.3	9H54M53.7S	1	3	3	3	3.5	0.14	**
55	140	140	****	1	******	*H**M****S	1	3	2	3	5.0	0.0	**
56	145	145	****	1	******	*H**M****S	1	2	2	0	5.0	0.0	**
57	151	151	****	1	******	*H**M****S	1	3	2	0	5.0	0.0	**
58	159	161	344.	2	-120.0	9H52M56.3S	1	2	2	4	5.0	0.20	**
59	121	128	195.	3	-30.0	9H54M59.5S	1	1	2	4	5.5	0.27	**
60	121	128	212.	2	-38.6	9H54M47.8S	2	2	3	0	4.0	0.25	**
61	121	128	233.	2	-47.1	9H54M36.1S	2	2	3	0	3.5	0.14	**
62	143	186	181.	8	-18.8	9H55M14.8S	1	3	0	6	****	****	**
63	114	143	275.	9	-30.0	9H54M59.5S	2	1	3	0	5.5	0.27	**
64	165	184	247.	4	-12.6	9H55M23.3S	1	1	2	0	7.0	0.0	**
65	5	19	197.	3	-6.4	9H55M31.8S	2	2	2	4	13.5	0.11	**
66	30	32	130.	?	-45.0	9H54M39.0S	2	1	2	0	5.0	0.0	**
67	41	43	198.	2	0.0	9H55M40.6S	2	2	3	0	4.0	0.0	**
68	58	66	185.	2	-11.2	9H55M25.2S	2	2	2	4	7.5	0.07	**
69	71	90	178.	6	-7.9	9H55M29.8S	2	2	2	0	4.0	0.25	**
70	58	65	167.	2	-21.4	9H55M11.3S	2	3	3	0	4.0	0.25	**
71	80	90	167.	4	-12.0	9H55M24.2S	2	3	3	5	3.0	0.33	**
72	11	15	260.	2	-15.0	9H55M20.1S	2	1	2	0	8.5	0.06	**
73	27	76	261.	12	-12.2	9H55M23.8S	2	1	2	0	6.0	0.17	2
74	11	73	273.	13	-16.5	9H55M18.1S	2	1	2	0	5.5	0.27	2
75	76	83	318.	5	-90.0	9H53M37.4S	2	2	2	4	7.0	0.14	**
76	91	91	****	1	******	*H**M****S	2	2	1	4	12.0	0.0	**

NEBZ (CONTINUED)

SPOT	DRIFT1	DRIFT2	DRIFT3	30DEV	LIFETIME (SEE TEXT)	WHY	PART	DATES PROMINENT	
44	******	******	******	1.50	**********208.****	1,9	****	***-***	***-***
45	******	******	******	*****	********** 2.	4,4	****	***-***	***-***
46	******	******	******	*****	********** 1.	4,7	****	***-***	***-***
47	******	******	******	*****	********** 1.	3,3	****	***-***	***-***
48	******	******	******	*****	********** 1.	3,3	****	***-***	***-***
49	******	******	******	*****	********** 1.	3,3	216	***-***	***-***
50	******	******	******	*****	********** 1.	3,3	216	***-***	***-***
51	******	******	******	*****	********** 1.	3,3	216	***-***	***-***
52	******	******	******	*****	********** 2.	3,1	216	***-***	***-***
53	******	******	******	*****	********** 4.	4,3	****	***-***	***-***
54	******	******	******	*****	********** 7.	0,7	231	***-***	***-***
55	******	******	******	*****	********** 1.	7,4	231	***-***	***-***
56	******	******	******	*****	********** 1.	4,7	217	***-***	***-***
57	******	******	******	*****	********** 1.	7,7	217	***-***	***-***
58	******	******	******	*****	********** 2.	3,3	217	***-***	***-***
59	******	******	******	*****	********** 7.	3,3	****	***-***	***-***
60	******	******	******	*****	********** 7.	3,3	****	***-***	***-***
61	******	******	******	*****	********** 7.	3,3	****	***-***	***-***
62	******	******	******	*****	********** 43.	3,3	****	***-***	***-***
63	******	******	******	*****	********** 29.	3,1	****	***-***	***-***
64	******	******	******	*****	********** 19.	2,3	****	***-***	***-***
65	******	******	******	*****	********** 14.	9,3	218	***-***	***-***
66	******	******	******	*****	********** 2.	3,5	218	***-***	***-***
67	******	******	******	*****	********** 2.	5,3	218	***-***	***-***
68	******	******	******	*****	********** 8.	3,5	219	***-***	***-***
69	******	******	******	*****	********** 19.	5,1	219	***-***	***-***
70	******	******	******	*****	********** 7.	3,3	232	***-***	***-***
71	******	******	******	*****	********** 10.	3,1	232	***-***	***-***
72	******	******	******	*****	********** 4.	3,3	220	***-***	***-***
73	******	******	******	0.0	********** 49.	3,1	220	***-***	***-***
74	******	******	******	0.0	**** 62.**********	1,0	****	***-***	***-***
75	******	******	******	*****	**** 7.**********	0,1	****	***-***	***-***
76	******	******	******	*****	********** 1.	1,4	****	***-***	***-***

NEBZ (CONTINUED)

SPOT	DATES OBSVD		LONG	NO.	DRIFT	ROT PERIOD	D,L	S	P	T	LENGTH	DL/L	DEV
77	71	73	294.	2	-75.0	9H53M57.9S	2	3	3	0	3.0	0.0	**
78	11	13	229.	2	-60.0	9H54M18.5S	2	1	?	4	6.0	0.17	**
79	30	37	321.	3	-21.4	9H55M11.3S	2	1	?	4	5.5	0.09	**
80	105	134	279.	9	-15.5	9H55M19.4S	2	1	3	4	4.5	0.56	1
81	141	148	286.	3	-17.1	9H55M17.1S	2	1	3	4	6.0	0.17	**
82	127	134	14.	4	-64.3	9H54M12.6S	2	2	2	5	10.0	0.40	**
83	141	143	5.	2	-60.0	9H54M18.5S	2	2	2	0	6.0	0.0	**
84	113	115	20.	2	-75.0	9H53M57.9S	2	2	2	0	6.5	0.08	**
85	115	144	20.	8	-59.0	9H54M19.9S	1	3	2	0	6.0	0.17	**
86	127	139	326.	5	-12.5	9H55M23.5S	?	2	2	4	5.5	0.27	**
87	103	105	321.	2	-30.0	9H54M59.5S	2	1	2	4	4.5	0.11	**
88	104	104	****	1	******	*H**M****S	2	2	2	0	5.0	0.0	**
89	121	121	****	1	******	*H**M****S	2	3	2	0	8.0	0.0	**
90	144	144	****	1	******	*H**M****S	2	2	3	0	3.0	0.0	**
91	144	144	****	1	******	*H**M****S	2	2	3	0	4.0	0.0	**
92	146	146	****	1	******	*H**M****S	2	2	3	0	2.0	0.0	**
93	146	146	****	1	******	*H**M****S	2	3	3	0	5.0	0.0	**
94	151	151	****	1	******	*H**M****S	2	2	2	0	7.0	0.0	**
95	158	158	****	1	******	*H**M****S	2	3	2	0	5.0	0.0	**
96	155	155	****	1	******	*H**M****S	2	2	3	4	3.0	0.0	**
97	155	155	****	1	******	*H**M****S	2	3	2	0	5.0	0.0	**
98	160	160	****	1	******	*H**M****S	2	2	3	0	3.0	0.0	**
99	174	174	****	1	******	*H**M****S	2	2	2	0	8.0	0.0	**
100	175	175	****	1	******	*H**M****S	?	2	2	4	9.0	0.0	**

NEBZ (CONTINUED)

SPOT	DRIFT1	DRIFT2	DRIFT3	30DEV	LIFETIME (SEE TEXT)		WHY	PART	DATES PROMINENT	
77	******	******	******	*****	**********	2.	1,1	****	***-***	***-***
78	******	******	******	*****	**********	2.	2,3	221	***-***	***-***
79	******	******	******	*****	**********	7.	3,0	221	***-***	***-***
80	******	******	******	0.0	**********	29.	3,4	222	***-***	***-***
81	******	******	******	*****	**********	7.	4,3	222	***-***	***-***
82	******	******	******	*****	**********	7.	7,4	233	***-***	***-***
83	******	******	******	*****	**********	2.	4,3	233	***-***	***-***
84	******	******	******	*****	**********	2.	1,7	****	***-***	***-***
85	******	******	******	*****	**********	29.	3,7	****	***-***	***-***
86	******	******	******	*****	**********	12.	7,4	****	***-***	***-***
87	******	******	******	*****	**********	2.	3,1	****	***-***	***-***
88	******	******	******	*****	**********	1.	3,3	****	***-***	***-***
89	******	******	******	*****	**********	1.	3,7	****	***-***	***-***
90	******	******	******	*****	**********	1.	3,4	****	***-***	***-***
91	******	******	******	*****	**********	1.	3,4	****	***-***	***-***
92	******	******	******	*****	**********	1.	4,7	****	***-***	***-***
93	******	******	******	*****	**********	1.	4,7	****	***-***	***-***
94	******	******	******	*****	**********	1.	7,3	****	***-***	***-***
95	******	******	******	*****	**********	1.	7,3	****	***-***	***-***
96	******	******	******	*****	**********	1.	4,4	****	***-***	***-***
97	******	******	******	*****	**********	1.	4,4	****	***-***	***-***
98	******	******	******	*****	**********	1.	4,3	****	***-***	***-***
99	******	******	******	*****	**********	1.	3,7	****	***-***	***-***
100	******	******	******	*****	**********	1.	3,1	****	***-***	***-***

THE NEBZ CURRENT. NOV 1966-JUNE 1967.

DEFINITE AND PROBABLE SPOTS

SPOT	DATES OBSVD		LONG	NO.	DRIFT	ROT PERIOD	D,L	S	P	T	LENGTH	DL/L	DEV
44	81	185	42.	27	-17.6	9H55M16.5S	2	2	1	0	12.5	0.36	3
45	89	91	121.	3	-165.0	9H51M54.7S	2	2	3	0	5.0	0.0	**
46	89	90	129.	2	-150.0	9H52M15.3S	2	2	2	0	4.0	0.0	**
47	103	104	141.	2	-60.0	9H54M18.5S	1	1	3	4	7.0	0.0	**
48	103	104	135.	2	-30.0	9H54M59.5S	1	2	4	4	4.0	0.0	**
53	126	130	104.	3	7.5	9H55M50.9S	2	2	3	0	3.0	0.33	**
54	121	128	180.	3	-34.3	9H54M53.7S	1	3	3	3	3.5	0.14	**
59	121	128	195.	3	-30.0	9H54M59.5S	1	1	2	4	5.5	0.27	**
60	121	128	212.	2	-38.6	9H54M47.8S	2	2	3	0	4.0	0.25	**
61	121	128	233.	2	-47.1	9H54M36.1S	2	2	3	0	3.5	0.14	**
62	143	186	181.	8	-18.8	9H55M14.8S	1	3	0	6	****	****	**
63	114	143	275.	9	-30.0	9H54M59.5S	2	1	3	0	5.5	0.27	**
64	165	184	247.	4	-12.6	9H55M23.3S	1	1	2	0	7.0	0.0	**
70	58	65	167.	2	-21.4	9H55M11.3S	2	3	3	0	4.0	0.25	**
71	80	90	167.	4	-12.0	9H55M24.2S	2	3	3	5	3.0	0.33	**
74	11	73	273.	13	-16.5	9H55M18.1S	2	1	2	0	5.5	0.27	2
75	76	83	318.	5	-90.0	9H53M37.4S	2	2	2	4	7.0	0.14	**
76	91	91	****	1	******	*H**M****S	2	2	1	4	12.0	0.0	**
77	71	73	294.	2	-75.0	9H53M57.9S	2	3	3	0	3.0	0.0	**
82	127	134	14.	4	-64.3	9H54M12.6S	2	2	2	5	10.0	0.40	**
83	141	143	5.	2	-60.0	9H54M18.5S	2	2	2	0	6.0	0.0	**
84	113	115	20.	2	-75.0	9H53M57.9S	2	2	2	0	6.5	0.08	**
85	115	144	20.	8	-59.0	9H54M19.9S	1	3	2	0	6.0	0.17	**
86	127	139	326.	5	-12.5	9H55M23.5S	2	2	2	4	5.5	0.27	**
87	103	105	321.	2	-30.0	9H54M59.5S	2	1	2	4	4.5	0.11	**
88	104	104	****	1	******	*H**M****S	2	2	2	0	5.0	0.0	**
89	121	121	****	1	******	*H**M****S	2	3	2	0	8.0	0.0	**
90	144	144	****	1	******	*H**M****S	2	2	3	0	3.0	0.0	**
91	144	144	****	1	******	*H**M****S	2	2	3	0	4.0	0.0	**
92	146	146	****	1	******	*H**M****S	2	2	3	0	2.0	0.0	**
93	146	146	****	1	******	*H**M****S	2	3	3	0	5.0	0.0	**
94	151	151	****	1	******	*H**M****S	2	2	2	0	7.0	0.0	**
95	158	158	****	1	******	*H**M****S	2	3	2	0	5.0	0.0	**

NEBZ (CONTINUED)

SPOT	DRIFT1	DRIFT2	DRIFT3	30DEV	LIFETIME (SEE TEXT)	WHY	PART	DATES PROMINENT	
44	******	******	******	1.50	**********208.****	1,9	****	***-***	***-***
45	******	******	******	*****	********** 2.	4,4	****	***-***	***-***
46	******	******	******	*****	********** 1.	4,7	****	***-***	***-***
47	******	******	******	*****	********** 1.	3,3	****	***-***	***-***
48	******	******	******	*****	********** 1.	3,3	****	***-***	***-***
53	******	******	******	*****	********** 4.	4,3	****	***-***	***-***
54	******	******	******	*****	********** 7.	0,7	231	***-***	***-***
59	******	******	******	*****	********** 7.	3,3	****	***-***	***-***
60	******	******	******	*****	********** 7.	3,3	****	***-***	***-***
61	******	******	******	*****	********** 7.	3,3	****	***-***	***-***
62	******	******	******	*****	********** 43.	3,3	****	***-***	***-***
63	******	******	******	*****	********** 29.	3,1	****	***-***	***-***
64	******	******	******	*****	********** 19.	2,3	****	***-***	***-***
70	******	******	******	*****	********** 7.	3,3	232	***-***	***-***
71	******	******	******	*****	********** 10.	3,1	232	***-***	***-***
74	******	******	******	0.0	**** 62.**********	1,0	****	***-***	***-***
75	******	******	******	*****	**** 7.**********	0,1	****	***-***	***-***
76	******	******	******	*****	********** 1.	1,4	****	***-***	***-***
77	******	******	******	*****	********** 2.	1,1	****	***-***	***-***
82	******	******	******	*****	********** 7.	7,4	233	***-***	***-***
83	******	******	******	*****	********** 2.	4,3	233	***-***	***-***
84	******	******	******	*****	********** 2.	1,7	****	***-***	***-***
85	******	******	******	*****	********** 29.	3,7	****	***-***	***-***
86	******	******	******	*****	********** 12.	7,4	****	***-***	***-***
87	******	******	******	*****	********** 2.	3,1	****	***-***	***-***
88	******	******	******	*****	********** 1.	3,3	****	***-***	***-***
89	******	******	******	*****	********** 1.	3,7	****	***-***	***-***
90	******	******	******	*****	********** 1.	3,4	****	***-***	***-***
91	******	******	******	*****	********** 1.	3,4	****	***-***	***-***
92	******	******	******	*****	********** 1.	4,7	****	***-***	***-***
93	******	******	******	*****	********** 1.	4,7	****	***-***	***-***
94	******	******	******	*****	********** 1.	7,3	****	***-***	***-***
95	******	******	******	*****	********** 1.	7,3	****	***-***	***-***

NEBZ (CONTINUED)

SPOT	DATES OBSVD	LONG	NO.	DRIFT	ROT PERIOD	D,L	S	P	T	LENGTH	DL/L	DEV
96	155 155	****	1	******	*H**M****S	2	2	3	4	3.0	0.0	**
97	155 155	****	1	******	*H**M****S	2	3	2	0	5.0	0.0	**
98	160 160	****	1	******	*H**M****S	2	2	3	0	3.0	0.0	**
99	174 174	****	1	******	*H**M****S	2	2	2	0	8.0	0.0	**
100	175 175	****	1	******	*H**M****S	2	2	2	4	9.0	0.0	**
216	103 130	142.	6	-26.7	9H55M 4.1S	1	2	0	4	****	****	**
217	140 161	305.	5	-105.7	9H53M15.9S	1	2	0	0	****	****	**
218	5 43	183.	7	-11.8	9H55M24.4S	2	2	1	4	9.5	0.58	**
219	58 90	181.	8	-16.9	9H55M17.5S	2	2	1	4	5.5	0.45	**
220	11 76	261.	14	-14.8	9H55M20.4S	2	1	1	0	7.0	0.29	2
221	11 37	327.	5	-17.3	9H55M16.9S	2	1	1	4	6.0	0.17	**
222	105 148	277.	12	-13.3	9H55M22.5S	2	1	1	4	4.5	0.56	1

NEBZ (CONTINUED)

SPOT	DRIFT1	DRIFT2	DRIFT3	30DEV	LIFETIME (SEE TEXT)		WHY	PART	DATES PROMINENT	
96	******	******	******	*****	**********	1.	4,4	****	***-***	***-***
97	******	******	******	*****	**********	1.	4,4	****	***-***	***-***
98	******	******	******	*****	**********	1.	4,3	****	***-***	***-***
99	******	******	******	*****	**********	1.	3,7	****	***-***	***-***
100	******	******	******	*****	**********	1.	3,1	****	***-***	***-***
216	******	******	******	*****	**********	27.	3,1	****	***-***	***-***
217	******	******	******	*****	**********	21.	7,3	****	***-***	***-***
218	******	******	******	0.0	**********	38.	9,3	****	***-***	***-***
219	******	******	******	*****	**********	32.	3,1	****	***-***	***-***
220	-15.5	******	******	1.50	**********	65.	3,1	****	***-***	***-***
221	******	******	******	*****	**********	26.	2,0	****	***-***	***-***
222	******	******	******	0.0	**********	43.	3,3	****	***-***	***-***

THE NEBZ CURRENT. NOV 1966-JUNE 1967.

DEFINITE, PROBABLE, AND POSSIBLE SPOTS

SPOT	DATES OBSVD		LONG	NO.	DRIFT	ROT PERIOD	D,L	S	P	T	LENGTH	DL/L	DEV
44	81	185	42.	27	-17.6	9H55M16.5S	2	2	1	0	12.5	0.36	3
45	89	91	121.	3	-165.0	9H51M54.7S	2	2	3	0	5.0	0.0	**
46	89	90	129.	2	-150.0	9H52M15.3S	2	2	2	0	4.0	0.0	**
47	103	104	141.	2	-60.0	9H54M18.5S	1	1	3	4	7.0	0.0	**
48	103	104	135.	2	-30.0	9H54M59.5S	1	2	4	4	4.0	0.0	**
53	126	130	104.	3	7.5	9H55M50.9S	2	2	3	0	3.0	0.33	**
59	121	128	195.	3	-30.0	9H54M59.5S	1	1	2	4	5.5	0.27	**
60	121	128	212.	2	-38.6	9H54M47.8S	2	2	3	0	4.0	0.25	**
61	121	128	233.	2	-47.1	9H54M36.1S	2	2	3	0	3.5	0.14	**
62	143	186	181.	8	-18.8	9H55M14.8S	1	3	0	6	****	****	**
63	114	143	275.	9	-30.0	9H54M59.5S	2	1	3	0	5.5	0.27	**
64	165	184	247.	4	-12.6	9H55M23.3S	1	1	2	0	7.0	0.0	**
74	11	73	273.	13	-16.5	9H55M18.1S	2	1	2	0	5.5	0.27	2
75	76	83	318.	5	-90.0	9H53M37.4S	2	2	2	4	7.0	0.14	**
76	91	91	****	1	******	*H**M****S	2	2	1	4	12.0	0.0	**
77	71	73	294.	2	-75.0	9H53M57.9S	2	3	3	0	3.0	0.0	**
84	113	115	20.	2	-75.0	9H53M57.9S	2	2	2	0	6.5	0.08	**
85	115	144	20.	8	-59.0	9H54M19.9S	1	3	2	0	6.0	0.17	**
86	127	139	326.	5	-12.5	9H55M23.5S	2	2	2	4	5.5	0.27	**
87	103	105	321.	2	-30.0	9H54M59.5S	2	1	2	4	4.5	0.11	**
88	104	104	****	1	******	*H**M****S	2	2	2	0	5.0	0.0	**
89	121	121	****	1	******	*H**M****S	2	3	2	0	8.0	0.0	**
90	144	144	****	1	******	*H**M****S	2	2	3	0	3.0	0.0	**
91	144	144	****	1	******	*H**M****S	2	2	3	0	4.0	0.0	**
92	146	146	****	1	******	*H**M****S	2	2	3	0	2.0	0.0	**
93	146	146	****	1	******	*H**M**** S	2	3	3	0	5.0	0.0	**
94	151	151	****	1	******	*H**M ****S	2	2	2	0	7.0	0.0	**
95	158	158	****	1	******	*H**M****S	2	3	2	0	5.0	0.0	**
96	155	155	****	1	******	*H **M****S	2	2	3	4	3.0	0.0	**
97	155	155	****	1	******	*H**M****S	2	3	2	0	5.0	0.0	**
98	160	160	****	1	******	*H**M****S	2	2	3	0	3.0	0.0	**
99	174	174	****	1	******	*H**M****S	2	2	2	0	8.0	0.0	**
100	175	175	****	1	******	*H**M****S	2	2	2	4	9.0	0.0	**

NFBZ (CONTINUED)

SPOT	DRIFT1	DRIFT2	DRIFT3	30DEV	LIFETIME (SEE TEXT)	WHY	PART	DATES PROMINENT	
44	******	******	******	1.50	**********208.****	1,9	****	***-***	***-***
45	******	******	******	*****	********** 2.	4,4	****	***-***	***-***
46	******	******	******	*****	********** 1.	4,7	****	***-***	***-***
47	******	******	******	*****	********** 1.	3,3	****	***-***	***-***
48	******	******	******	*****	********** 1.	3,3	****	***-***	***-***
53	******	******	******	*****	********** 4.	4,3	****	***-***	***-***
59	******	******	******	*****	********** 7.	3,3	****	***-***	***-***
60	******	******	******	*****	********** 7.	3,3	****	***-***	***-***
61	******	******	******	*****	********** 7.	3,3	****	***-***	***-***
62	******	******	******	*****	********** 43.	3,3	****	***-***	***-***
63	******	******	******	*****	********** 29.	3,1	****	***-***	***-***
64	******	******	******	*****	********** 19.	2,3	****	***-***	***-***
74	******	******	******	0.0	**** 62.**********	1,0	****	***-***	***-***
75	******	******	******	*****	**** 7.**********	0,1	****	***-***	***-***
76	******	******	******	*****	********** 1.	1,4	****	***-***	***-***
77	******	******	******	*****	********** 2.	1,1	****	***-***	***-***
84	******	******	******	*****	********** 2.	1,7	****	***-***	***-***
85	******	******	******	*****	********** 29.	3,7	****	***-***	***-***
86	******	******	******	*****	********** 12.	7,4	****	***-***	***-***
87	******	******	******	*****	********** 2.	3,1	****	***-***	***-***
88	******	******	******	*****	********** 1.	3,3	****	***-***	***-***
89	******	******	******	*****	********** 1.	3,7	****	***-***	***-***
90	******	******	******	*****	********** 1.	3,4	****	***-***	***-***
91	******	******	******	*****	********** 1.	3,4	****	***-***	***-***
92	******	******	******	*****	********** 1.	4,7	****	***-***	***-***
93	******	******	******	*****	********** 1.	4,7	****	***-***	***-***
94	******	******	******	*****	********** 1.	7,3	****	***-***	***-***
95	******	******	******	*****	********** 1.	7,3	****	***-***	***-***
96	******	******	******	*****	********** 1.	4,4	****	***-***	***-***
97	******	******	******	*****	********** 1.	4,4	****	***-***	***-***
98	******	******	******	*****	********** 1.	4,3	****	***-***	***-***
99	******	******	******	*****	********** 1.	3,7	****	***-***	***-***
100	******	******	******	*****	********** 1.	3,1	****	***-***	***-***

NEBZ (CONTINUED)

SPOT	DATES OBSVD	LONG	NO.	DRIFT	ROT PERIOD	D,L	S	P	T	LENGTH	DL/L	DEV
216	103 130	142.	6	-26.7	9H55M 4.1S	1	2	0	4	****	****	**
217	140 161	305.	5	-105.7	9H53M15.9S	1	2	0	0	****	****	**
218	5 43	183.	7	-11.8	9H55M24.4S	2	2	1	4	9.5	0.58	**
219	58 90	181.	8	-16.9	9H55M17.5S	2	2	1	4	5.5	0.45	**
220	11 76	261.	14	-14.8	9H55M20.4S	2	1	1	0	7.0	0.29	2
221	11 37	327.	5	-17.3	9H55M16.9S	2	1	1	4	6.0	0.17	**
222	105 148	277.	12	-13.3	9H55M22.5S	2	1	1	4	4.5	0.56	1
231	121 140	217.	4	-61.6	9H54M16.3S	1	3	1	3	4.0	0.25	**
232	58 90	169.	6	-18.8	9H55M14.9S	2	3	1	0	3.5	0.43	**
233	127 143	13.	6	-63.7	9H54M13.3S	2	2	1	5	10.0	0.40	**

NEBZ (CONTINUED)

SPOT	DRIFT1	DRIFT2	DRIFT3	30DEV	LIFETIME (SEE TEXT)		WHY	PART	DATES PROMINENT	
216	******	******	******	*****	**********	27.	3,1	****	***-***	***-***
217	******	******	******	*****	**********	21.	7,3	****	***-***	***-***
218	******	******	******	0.0	**********	38.	9,3	****	***-***	***-***
219	******	******	******	*****	**********	32.	3,1	****	***-***	***-***
220	-15.5	******	******	1.50	**********	65.	3,1	****	***-***	***-***
221	******	******	******	*****	**********	26.	2,0	****	***-***	***-***
222	******	******	******	0.0	**********	43.	3,3	****	***-***	***-***
231	******	******	******	*****	**********	19.	0,4	****	***-***	***-***
232	******	******	******	*****	**********	32.	3,1	****	***-***	***-***
233	******	******	******	*****	**********	16.	7,3	****	***-***	***-***

THE NEBN CURRENT. NOV 1966-JUNE 1967.

DEFINITE SPOTS

SPOT	DATES OBSVD	LONG	NO.	DRIFT	ROT PERIOD	D,L	S	P	T	LENGTH	DL/L	DEV
1	1 220	6.	59	-11.9	9H55M24.3S	2	3	2	0	3.5	0.43	2
2	6 105	28.	54	-12.1	9H55M24.0S	1	1	2	4	10.5	0.24	2
3	9 221	40.	51	-14.2	9H55M21.2S	2	3	3	0	3.5	0.43	1
4	69 202	48.	42	-16.0	9H55M18.7S	1	1	2	4	11.5	0.22	1
5	2 219	88.	52	-11.2	9H55M25.3S	2	2	3	0	6.5	0.23	2
6	2 72	85.	19	-17.1	9H55M17.1S	2	2	2	0	6.5	0.23	3
7	11 46	82.	10	-16.3	9H55M18.3S	1	2	3	0	5.5	0.27	2
8	123 145	61.	7	-5.5	9H55M33.1S	1	1	0	7	****	****	**
9	171 190	73.	7	-14.2	9H55M21.2S	1	1	3	4	4.5	0.11	**
10	94 130	92.	7	-3.3	9H55M36.0S	1	1	2	4	8.5	0.18	**
11	2 181	124.	37	-13.1	9H55M22.7S	2	1	2	0	8.0	0.25	1
12	200 203	264.	3	-50.0	9H54M32.2S	2	2	2	0	5.0	0.0	**
13	34 75	127.	7	-13.9	9H55M21.6S	1	2	3	4	10.0	0.10	3
14	5 72	133.	13	-15.7	9H55M19.2S	2	1	3	4	7.5	0.20	3
15	36 181	143.	25	-13.4	9H55M22.2S	1	2	2	0	6.5	0.23	3
16	140 150	215.	4	-24.0	9H55M 7.8S	2	2	3	0	3.0	0.0	**
17	140 208	192.	11	-6.2	9H55M32.2S	2	3	3	0	3.0	0.0	2
18	76 225	220.	30	-8.3	9H55M29.3S	2	3	3	0	3.5	0.14	1
19	73 76	252.	2	-20.0	9H55M13.2S	1	3	3	3	3.0	0.0	**
20	1 182	269.	40	-14.9	9H55M20.2S	2	3	2	0	5.0	0.40	1
21	208 225	275.	4	-15.9	9H55M18.9S	2	2	2	0	4.5	0.11	**
22	1 78	273.	14	-21.0	9H55M11.8S	2	3	2	0	5.5	0.45	2
23	1 182	305.	35	-14.6	9H55M20.6S	2	2	3	0	4.5	0.33	3
24	11 13	319.	2	-15.0	9H55M20.1S	2	2	2	4	3.5	0.14	**
25	30 37	316.	2	-17.1	9H55M17.1S	2	2	2	4	3.0	0.0	**
26	127 158	325.	9	-7.7	9H55M30.0S	2	2	3	0	3.0	0.0	2
27	173 175	294.	2	0.0	9H55M40.6S	2	2	3	0	3.0	0.0	**
28	193 204	322.	3	-8.2	9H55M29.4S	2	3	2	0	5.0	0.20	**
29	127 220	329.	16	-7.1	9H55M30.9S	1	2	3	4	6.0	0.33	2
30	120 158	352.	9	-14.2	9H55M21.2S	1	2	2	4	4.0	0.25	**
31	172 174	202.	2	-15.0	9H55M20.1S	2	1	3	4	3.0	0.0	**
32	173 175	287.	2	0.0	9H55M40.6S	1	2	3	0	6.0	0.0	**
33	104 104	****	1	******	*H**M****S	2	2	2	0	4.0	0.0	**

NEBN (CONTINUED)

SPOT	DRIFT1	DRIFT2	DRIFT3	30DEV	LIFETIME (SEE TEXT)	WHY	PART	DATES PROMINENT	
1	-15.5	-11.5	-10.0	2.11	**********219.	9,9	****	91-220	***-***
2	-9.5	******	******	4.22	********198.**********	9,0	****	15-103	***-***
3	-11.0	-13.5	-16.5	2.00	**********212.	9,9	****	87-209	***-***
4	******	-15.0	-17.5	1.62	********266.**********	0,9	****	87-171	***-***
5	-11.5	-10.5	-10.5	1.50	**********217.	9,9	****	87-192	***-***
6	******	******	******	0.0	********140.**********	9,0	****	***-***	***-***
7	******	******	******	0.0	******** 70.**********	9,0	****	***-***	***-***
8	******	******	******	*****	34.**********	0,0	****	***-***	***-***
9	******	******	******	*****	********** 19.	5,5	****	***-***	***-***
10	******	******	******	*****	**** 36.**********	0,1	****	***-***	***-***
11	-14.0	-13.0	******	1.04	**********179.	9,3	211	34-134	***-***
12	******	******	******	*****	********** 3.	3,9	211	***-***	***-***
13	******	******	******	0.0	**** 41.**********	1,0	****	***-***	***-***
14	******	******	******	0.0	********134.**********	9,0	****	***-***	***-***
15	******	-15.5	******	1.75	**********145.	0,3	****	46-105	***-***
16	******	******	******	*****	********** 10.	3,7	****	***-***	***-***
17	******	******	******	0.0	********** 68.	7,9	****	155-196	***-***
18	******	******	-9.0	1.33	********298.**********	0,9	****	95-202	***-***
19	******	******	******	*****	9.**********	0,0	****	***-***	***-***
20	-13.0	-18.0	-13.0	2.67	**********181.	9,3	212	1- 80	103-182
21	******	******	******	*****	********** 17.	3,9	212	***-***	***-***
22	-21.0	******	******	1.00	********154.**********	9,0	****	***-***	***-***
23	-15.0	-13.5	******	1.36	**********181.	9,3	****	***-***	***-***
24	******	******	******	*****	********** 2.	9,3	213	***-***	***-***
25	******	******	******	*****	********** 7.	3,1	213	***-***	***-***
26	******	******	******	0.0	********** 31.	0,3	214	***-***	***-***
27	******	******	******	*****	********** 2.	3,3	214	***-***	***-***
28	******	******	******	*****	********** 11.	3,9	****	***-***	***-***
29	******	******	-8.0	3.00	********186.**********	0,9	****	***-***	***-***
30	******	******	******	*****	**** 38.**********	1,0	****	***-***	***-***
31	******	******	******	*****	********** 2.	2,5	****	***-***	***-***
32	******	******	******	*****	********** 2.	3,3	****	***-***	***-***
33	******	******	******	*****	********** 1.	3,3	****	***-***	***-***

NEBN (CONTINUED)

SPOT	DATES	OBSVD	LONG	NO.	DRIFT	ROT PERIOD	D,L	S	P	T	LENGTH	DL/L	DEV
34	82	88	282.	2	-10.0	9H55M26.9S	2	2	3	0	2.5	0.20	**
35	15	15	****	1	******	*H**M****S	2	3	2	0	2.0	0.0.	**

NEBN (CONTINUED)

SPOT	DRIFT1	DRIFT2	DRIFT3	30DEV	LIFETIME (SEE TEXT)		WHY	PART	DATES PROMINENT	
34	******	******	******	*****	**********	6.	1,1	****	***-***	***-***
35	******	******	******	*****	**********	1.	5,5	****	***-***	***-***

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DEFINITE AND PROBABLE SPOTS

SPOT	DATES OBSVD	LONG	NO.	DRIFT	ROT PERIOD	D,L	S	P	T	LENGTH	DL/L	DEV
1	1 220	6.	59	-11.9	9H55M24.3S	2	3	2	0	3.5	0.43	2
2	6 105	28.	54	-12.1	9H55M24.0S	1	1	2	4	10.5	0.24	2
3	9 221	40.	51	-14.2	9H55M21.2S	2	3	3	0	3.5	0.43	1
4	69 202	48.	42	-16.0	9H55M18.7S	1	1	2	4	11.5	0.22	1
5	2 219	88.	52	-11.2	9H55M25.3S	2	2	3	0	6.5	0.23	2
6	2 72	85.	19	-17.1	9H55M17.1S	2	2	2	0	6.5	0.23	3
7	11 46	82.	10	-16.3	9H55M18.3S	1	2	3	0	5.5	0.27	2
8	123 145	61.	7	-5.5	9H55M33.1S	1	1	0	7	****	****	**
9	171 190	73.	7	-14.2	9H55M21.2S	1	1	3	4	4.5	0.11	**
10	94 130	92.	7	-3.3	9H55M36.0S	1	1	2	4	8.5	0.18	**
13	34 75	127.	7	-13.9	9H55M21.6S	1	2	3	4	10.0	0.10	3
14	5 72	133.	13	-15.7	9H55M19.2S	2	1	3	4	7.5	0.20	3
15	36 181	143.	25	-13.4	9H55M22.2S	1	2	2	0	6.5	0.23	3
16	140 150	215.	4	-24.0	9H55M 7.8S	2	2	3	0	3.0	0.0	**
17	140 208	192.	11	-6.2	9H55M32.2S	2	3	3	0	3.0	0.0	2
18	76 225	220.	30	-8.3	9H55M29.3S	2	3	3	0	3.5	0.14	1
19	73 76	252.	2	-20.0	9H55M13.2S	1	3	3	3	3.0	0.0	**
22	1 78	273.	14	-21.0	9H55M11.8S	2	3	2	0	5.5	0.45	2
23	1 182	305.	35	-14.6	9H55M20.6S	2	2	3	0	4.5	0.33	3
28	193 204	322.	3	-8.2	9H55M29.4S	2	3	2	0	5.0	0.20	**
29	127 220	329.	16	-7.1	9H55M30.9S	1	2	3	4	6.0	0.33	2
30	120 158	352.	9	-14.2	9H55M21.2S	1	2	2	4	4.0	0.25	**
31	172 174	202.	2	-15.0	9H55M20.1S	2	1	3	4	3.0	0.0	**
32	173 175	287.	2	0.0	9H55M40.6S	1	2	3	0	6.0	0.0	**
33	104 104	****	1	******	*H**M****S	2	2	2	0	4.0	0.0	**
34	82 88	282.	2	-10.0	9H55M26.9S	2	2	3	0	2.5	0.20	**
35	15 15	****	1	******	*H**M****S	2	3	2	0	2.0	0.0	**
211	2 203	120.	40	-14.8	9H55M20.4S	2	1	1	0	7.5	0.33	1
212	1 225	269.	44	-14.7	9H55M20.4S	2	2	1	0	5.0	0.40	1
213	11 37	321.	4	-13.8	9H55M21.7S	2	2	1	4	3.5	0.14	**
214	127 175	332.	11	-11.9	9H55M24.4S	2	2	1	0	3.0	0.0	2

NEBN (CONTINUED)

SPOT	DRIFT1	DRIFT2	DRIFT3	3ODEV	LIFETIME (SEE TEXT)	WHY	PART	DATES PROMINENT
1	-15.5	-11.5	-10.0	2.11	**********219.	9,9	****	91-220 ***-***
2	-9.5	******	******	4.22	********198.**********	9,0	****	15-103 ***-***
3	-11.0	-13.5	-16.5	2.00	**********212.	9,9	****	87-209 ***-***
4	******	-15.0	-17.5	1.62	********266.**********	0,9	****	87-171 ***-***
5	-11.5	-10.5	-10.5	1.50	**********217.	9,9	****	87-192 ***-***
6	******	******	******	0.0	********140.**********	9,0	****	***-*** ***-***
7	******	******	******	0.0	******** 70.**********	9,0	****	***-*** ***-***
8	******	******	******	*****	34.**********	0,0	****	***-*** ***-***
9	******	******	******	*****	********** 19.	5,5	****	***-*** ***-***
10	******	******	******	*****	**** 36.**********	0,1	****	***-*** ***-***
13	******	******	******	0.0	**** 41.**********	1,0	****	***-*** ***-***
14	******	******	******	0.0	*********134.**********	9,0	****	***-*** ***-***
15	******	-15.5	******	1.75	**********145.	0,3	****	46-105 ***-***
16	******	******	******	*****	********** 10.	3,7	****	***-*** ***-***
17	******	******	******	0.0	********** 68.	7,9	****	155-196 ***-***
18	******	******	-9.0	1.33	********298.**********	0,9	****	95-202 ***-***
19	******	******	******	*****	9.**********	0,0	****	***-*** ***-***
22	-21.0	******	******	1.00	********154.**********	9,0	****	***-*** ***-***
23	-15.0	-13.5	******	1.36	**********181.	9,3	****	***-*** ***-***
28	******	******	******	*****	********** 11.	3,9	****	***-*** ***-***
29	******	******	-8.0	3.00	*********186.**********	0,9	****	***-*** ***-***
30	******	******	******	*****	**** 38.**********	1,0	****	***-*** ***-***
31	******	******	******	*****	********** 2.	2,5	****	***-*** ***-***
32	******	******	******	*****	********** 7.	3,3	****	***-*** ***-***
33	******	******	******	*****	********** 1.	3,3	****	***-*** ***-***
34	******	******	******	*****	********** 6.	1,1	****	***-*** ***-***
35	******	******	******	*****	********** 1.	5,5	****	***-*** ***-***
211	-14.0	-13.0	******	1.04	**********201.	9,9	****	***-*** ***-***
212	-13.0	-18.0	-13.0	2.67	**********224.	9,9	****	***-*** ***-***
213	******	******	******	*****	********** 52.****	9,1	****	***-*** ***-***
214	******	******	******	0.0	********** 48.	0,3	****	***-*** ***-***

THE NTRZ CURRENT. NOV 1966-JUNE 1967.

DEFINITE SPOTS

SPOT	DATES	OBSVD	LONG	NO.	DRIFT	ROT PERIOD	D,L	S	P	T	LENGTH	DL/L	DEV
36	2	9	12.	3	-21.4	9H55M11.3S	2	1	2	2	5.5	0.09	**
37	16	16	****	1	******	*H**M****S	2	2	2	2	7.0	0.0	**
38	70	70	****	1	******	*H**M****S	2	2	3	0	2.0	0.0	**
39	104	104	****	1	******	*H**M****S	2	2	2	2	5.0	0.0	**
40	121	139	76.	8	-11.7	9H55M24.6S	2	1	1	0	11.0	0.09	**
41	158	158	****	1	******	*H**M****S	2	1	2	0	6.0	0.0	**
42	103	103	****	1	******	*H**M****S	1	2	4	1	2.0	0.0	**
43	145	145	****	1	******	*H**M****S	1	2	4	1	4.0	0.0	**

NTRZ (CONTINUED)

SPOT	DRIFT1	DRIFT2	DRIFT3	30DEV	LIFETIME (SEE TEXT)		WHY	PART	DATES PROMINENT	
36	******	******	******	*****	**********	7.	9,2	215	***-***	***-***
37	******	******	******	*****	**********	1.	2,1	215	***-***	***-***
38	******	******	******	*****	**********	1.	5,2	****	***-***	***-***
39	******	******	******	*****	**********	1.	5,5	****	***-***	***-***
40	******	******	******	*****	**********	18.	1,1	****	***-***	***-***
41	******	******	******	*****	**********	1.	2,1	****	***-***	***-***
42	******	******	******	*****	**********	1.	1,1	****	***-***	***-***
43	******	******	******	*****	**********	1.	1,5	****	***-***	***-***

THE NTRZ CURRENT. NOV 1966-JUNE 1967.

DEFINITE AND PROBABLE SPOTS

SPOT	DATES OBSVD		LONG	NO.	DRIFT	ROT PERIOD	D,L	S	P	T	LENGTH	DL/L	DEV
38	70	70	****	1	******	*H**M****S	2	2	3	0	2.0	0.0	**
39	104	104	****	1	******	*H**M****S	2	2	2	2	5.0	0.0	**
40	121	139	76.	8	-11.7	9H55M24.6S	2	1	1	0	11.0	0.09	**
41	158	158	****	1	******	*H**M****S	2	1	2	0	6.0	0.0	**
42	103	103	****	1	******	*H**M****S	1	2	4	1	2.0	0.0	**
43	145	145	****	1	******	*H**M****S	1	2	4	1	4.0	0.0	**
215	2	16	29.	4	-15.0	9H55M20.1S	2	1	1	2	6.0	0.17	**

NTRZ (CONTINUED)

SPOT	DRIFT1	DRIFT2	DRIFT3	30DEV	LIFETIME (SEE TEXT)		WHY	PART	DATES PROMINENT	
38	******	******	******	*****	**********	1.	5,2	****	***-***	***-***
39	******	******	******	*****	**********	1.	5,5	****	***-***	***-***
40	******	******	******	*****	**********	18.	1,1	****	***-***	***-***
41	******	******	******	*****	**********	1.	2,1	****	***-***	***-***
42	******	******	******	*****	**********	1.	1,1	****	***-***	***-***
43	******	******	******	*****	**********	1.	1,5	****	***-***	***-***
215	******	******	******	*****	**********	28.****	9,1	****	***-***	***-***

THE NTBS CURRENT. NOV 1966-JUNE 1967.

DEFINITE SPOTS

SPOT	DATES OBSVD	LONG	NO.	DRIFT	ROT PERIOD	D,L	S	P	T	LENGTH	DL/L	DEV
190	5 27	319.	4	32.7	9H56M25.4S	2	2	1	5	6.0	0.17	**

NTBS (CONTINUED)

SPOT	DRIFT1	DRIFT2	DRIFT3	30DEV	LIFETIME (SEE TEXT)		WHY	PART	DATES PROMINENT	
190	******	******	******	*****	**********	22.	9,2	****	***-***	***-***

THE NTB CURRENT. NOV 1966-JUNE 1967.

DEFINITE SPOTS

SPOT	DATES	OBSVD	LONG	NO.	DRIFT	ROT PERIOD	D,L	S	P	T	LENGTH	DL/L	DEV
101	37	52	60.	6	34.0	9H56M27.2S	1	2	2	2	5.5	0.27	**
102	47	52	43.	3	6.0	9H55M48.8S	1	1	2	2	9.0	0.11	**
103	60	69	72.	4	40.0	9H56M35.4S	1	1	2	2	7.0	0.43	**
104	78	79	59.	2	30.0	9H56M21.7S	1	1	3	2	4.0	0.0	**
105	80	82	63.	2	15.0	9H56M 1.1S	1	2	3	3	3.0	0.0	**
106	72	87	34.	9	22.0	9H56M10.7S	2	2	3	0	6.0	0.17	**
107	88	94	23.	0	20.0	9H56M 8.0S	1	2	0	7	****	****	**
108	87	160	41.	15	31.6	9H56M23.9S	2	2	3	0	7.0	0.43	2
109	172	174	137.	2	0.0	9H55M40.6S	2	2	2	0	6.0	0.0	**
110	186	196	32.	3	33.0	9H56M25.8S	2	3	2	0	6.5	0.23	**
111	46	49	57.	3	10.0	9H55M54.3S	2	1	2	0	6.5	0.23	**
112	28	30	32.	2	0.0	9H55M40.6S	2	1	2	4	6.5	0.23	**
113	6	16	66.	6	18.0	9H56M 5.3S	1	2	3	2	4.0	0.25	**
114	28	49	71.	11	18.6	9H56M 6.0S	1	2	1	2	10.0	0.20	**
115	58	58	****	1	******	*H**M****S	1	1	2	2	5.0	0.0	**
116	65	80	86.	6	28.0	9H56M18.9S	1	2	2	2	7.5	0.33	**
117	82	82	****	1	******	*H**M****S	1	2	2	0	5.0	0.0	**
118	87	104	86.	6	21.2	9H56M 9.6S	1	1	2	2	5.5	0.27	**
119	113	186	89.	14	20.5	9H56M 8.7S	1	3	2	3	7.0	0.43	2
120	6	13	82.	4	17.1	9H56M 4.1S	2	2	0	7	****	****	**
121	11	16	99.	4	30.0	9H56M21.7S	2	1	3	0	5.0	0.20	**
122	1	21	108.	9	19.5	9H56M 7.3S	1	1	3	4	7.5	0.33	**
123	35	65	112.	7	24.0	9H56M13.5S	1	1	2	4	8.0	0.0	**
124	50	77	140.	5	22.2	9H56M11.0S	2	1	1	5	9.5	0.26	**
125	72	82	144.	4	33.0	9H56M25.8S	1	2	2	0	3.5	0.14	**
126	65	96	90.	10	25.2	9H56M15.1S	2	2	3	0	5.5	0.27	**
127	72	104	96.	11	26.2	9H56M16.6S	1	1	3	4	6.5	0.23	**
128	79	130	67.	13	25.9	9H56M16.0S	1	3	3	3	4.5	0.11	**
129	143	160	53.	4	33.5	9H56M26.5S	1	1	3	4	4.5	0.11	**
130	7	96	158.	23	25.6	9H56M15.7S	1	2	3	2	4.5	0.33	2
131	28	110	165.	20	24.1	9H56M13.7S	1	2	3	4	6.0	0.33	2
132	77	90	177.	6	23.1	9H56M12.2S	1	2	3	0	2.5	0.20	**
133	2	28	178.	7	23.1	9H56M12.2S	1	2	2	2	9.0	0.22	**

NTB (CONTINUED)

SPOT	DRIFT1	DRIFT2	DRIFT3	30DEV	LIFETIME (SEE TEXT)	WHY	PART	DATES PROMINENT	
101	******	******	******	*****	********** 15.	1,3	****	***-***	***-***
102	******	******	******	*****	********** 5.	0,3	****	***-***	***-***
103	******	******	******	*****	********** 9.	3,4	****	***-***	***-***
104	******	******	******	*****	********** 1.	2,2	****	***-***	***-***
105	******	******	******	*****	********** 2.	4,7	****	***-***	***-***
106	******	******	******	*****	17.**********	0,0	****	***-***	***-***
107	******	******	******	*****	**** 6.**********	0,1	****	***-***	***-***
108	******	******	******	3.00	********** 73.	0,3	223	***-***	***-***
109	******	******	******	*****	********** 2.	3,3	223	***-***	***-***
110	******	******	******	*****	********** 10.	3,9	223	***-***	***-***
111	******	******	******	*****	********** 3.	1,3	****	***-***	***-***
112	******	******	******	*****	********** 2.	3,2	****	***-***	***-***
113	******	******	******	*****	********** 10.	9,3	224	***-***	***-***
114	******	******	******	*****	********** 21.	3,3	224	***-***	***-***
115	******	******	******	*****	********** 1.	3,3	225	***-***	***-***
116	******	******	******	*****	********** 15.	3,4	225	***-***	***-***
117	******	******	******	*****	********** 1.	4,4	225	***-***	***-***
118	******	******	******	*****	********** 17.	7,3	225	***-***	***-***
119	******	******	******	0.0	********** 73.	3,3	225	121-175	***-***
120	******	******	******	*****	******** 14.**********	9,0	****	***-***	***-***
121	******	******	******	*****	********** 5.	2,5	****	***-***	***-***
122	******	******	******	*****	********** 20.	9,7	****	***-***	***-***
123	******	******	******	*****	********** 30.	5,5	****	***-***	***-***
124	******	******	******	*****	********** 27.	2,1	****	***-***	***-***
125	******	******	******	*****	********** 10.	1,3	****	***-***	***-***
126	******	******	******	*****	**** 31.**********	0,1	****	***-***	***-***
127	******	******	******	*****	********** 32.	8,3	****	***-***	***-***
128	******	******	******	*****	********** 51.	4,3	226	***-***	***-***
129	******	******	******	*****	********** 17.	3,3	226	***-***	***-***
130	25.0	******	******	2.00	********178.**********	9,0	****	***-***	***-***
131	******	******	******	1.50	********** 82.	1,1	****	***-***	***-***
132	******	******	******	*****	********** 13.	2,1	****	***-***	***-***
133	******	******	******	*****	********** 26.	9,5	****	***-***	***-***

NTB (CONTINUED)

SPOT	DATES	OBSVD	LONG	NO.	DRIFT	ROT PERIOD	D,L	S	P	T	LENGTH	DL/L	DEV
134	65	104	190.	6	25.4	9H56M15.4S	2	3	0	6	****	****	0
135	126	175	185.	7	22.7	9H56M11.6S	2	3	0	6	****	****	4
136	104	175	200.	11	22.0	9H56M10.7S	2	3	1	0	18.0	0.28	0
137	36	95	226.	11	22.9	9H56M11.9S	1	2	2	2	12.5	0.36	4
138	87	95	242.	3	11.2	9H55M56.0S	1	2	2	0	4.5	0.11	**
139	15	19	214.	2	7.5	9H55M50.9S	1	1	3	4	8.0	0.25	**
140	32	32	****	1	******	*H**M****S	1	1	2	4	10.0	0.0	**
141	5	5	****	1	******	*H**M****S	1	3	2	2	4.0	0.0	**
142	15	19	243.	2	15.0	9H56M 1.1S	1	2	3	0	3.0	0.0	**
143	37	58	265.	6	34.3	9H56M27.6S	1	2	0	7	****	****	**
144	76	202	245.	26	24.0	9H56M13.5S	1	2	3	2	7.5	0.33	3
145	76	80	255.	2	45.0	9H56M42.2S	1	2	2	0	3.0	0.0	**
146	71	134	257.	19	22.4	9H56M11.2S	1	2	2	0	5.5	0.27	2
147	49	49	****	1	******	*H**M****S	2	3	1	0	6.0	0.0	**
148	59	95	267.	11	22.5	9H56M11.4S	2	2	2	0	6.5	0.23	**
149	105	110	260.	2	30.0	9H56M21.7S	2	2	3	0	4.0	0.0	**
150	5	225	219.	43	0.0	9H55M40.6S	1	1	2	2	6.0	0.33	4
151	5	39	283.	6	22.1	9H56M10.8S	2	2	2	0	7.5	0.20	**
152	69	105	290.	8	16.7	9H56M 3.4S	1	2	2	0	5.0	0.20	3
153	37	88	313.	14	25.3	9H56M15.2S	1	1	2	2	8.5	0.29	3
154	69	73	336.	3	30.0	9H56M21.7S	1	2	3	2	2.5	0.20	**
155	64	202	327.	36	0.0	9H55M40.6S	1	3	2	2	6.5	0.23	4
156	64	134	341.	24	0.0	9H55M40.6S	1	1	2	2	6.5	0.23	4
157	1	16	354.	3	12.0	9H55M57.0S	1	1	2	4	11.0	0.09	**
158	30	43	357.	3	13.8	9H55M59.6S	1	1	3	4	10.0	0.30	**
159	64	105	355.	19	0.0	9H55M40.6S	1	2	2	4	8.0	0.13	5
160	1	79	348.	24	0.0	9H55M40.6S	1	2	0	7	****	****	5
161	15	20	285.	2	30.0	9H56M21.7S	2	3	1	0	11.5	0.04	**
162	115	152	4.	14	30.8	9H56M22.8S	1	2	2	0	6.0	0.17	**
163	127	140	353.	0	13.8	9H55M59.6S	2	2	2	0	6.5	0.23	**
164	152	188	338.	9	20.0	9H56M 8.0S	2	1	3	0	8.5	0.18	**
165	113	212	351.	25	0.0	9H55M40.6S	1	3	3	2	6.0	0.17	2
166	113	183	339.	17	0.0	9H55M40.6S	1	2	2	4	9.0	0.11	0

NTB (CONTINUED)

SPOT	DRIFT1	DRIFT2	DRIFT3	30DEV	LIFETIME (SEE TEXT)	WHY	PART	DATES PROMINENT	
134	******	******	******	0.0	********** 39.	3,3	227	***-***	***-***
135	******	******	******	0.0	********** 49.	3,3	227	***-***	***-***
136	******	******	******	4.50	********** 71.	8,3	****	126-141	***-***
137	******	******	******	0.0	********** 59.	1,3	****	64- 91	***-***
138	******	******	******	*****	********** 8.	0,3	****	***-***	***-***
139	******	******	******	*****	********** 4.	1,3	234	***-***	***-***
140	******	******	******	*****	********** 1.	3,0	234	***-***	***-***
141	******	******	******	*****	********** 1.	9,3	228	***-***	***-***
142	******	******	******	*****	********** 4.	3,5	228	***-***	***-***
143	******	******	******	*****	********** 21.********	1,8	****	***-***	***-***
144	******	******	22.0	0.44	********252.**********	0,9	****	105-173	***-***
145	******	******	******	*****	********** 4.	2,2	****	***-***	***-***
146	******	******	******	0.0	**** 63.**********	1,0	****	***-***	***-***
147	******	******	******	*****	********** 1.	1,3	229	***-***	***-***
148	******	******	******	*****	********** 36.	3,7	229	***-***	***-***
149	******	******	******	*****	********** 5.	7,1	229	***-***	***-***
150	22.5	24.0	20.5	2.78	**********220.	9,9	****	***-***	***-***
151	******	******	******	*****	********** 68.****	9,1	****	***-***	***-***
152	******	******	******	0.0	********** 36.	1,1	****	***-***	***-***
153	******	******	******	0.0	********** 51.	1,1	****	***-***	***-***
154	******	******	******	*****	********** 4.	2,2	****	***-***	***-***
155	******	23.0	18.0	2.75	********276.**********	0,9	****	91-152	***-***
156	******	******	******	0.0	********** 70.	0,4	****	***-***	***-***
157	******	******	******	*****	********** 15.	9,3	235	***-***	***-***
158	******	******	******	*****	********** 13.	3,2	236	***-***	***-***
159	******	******	******	0.0	********** 41.	2,7	236	***-***	***-***
160	15.0	******	******	4.00	********156.**********	9,0	****	***-***	***-***
161	******	******	******	*****	********** 5.	1,3	****	***-***	***-***
162	******	******	******	*****	**** 37.**********	0,1	****	***-***	***-***
163	******	******	******	*****	********** 13.	8,3	230	***-***	***-***
164	******	******	******	*****	********** 36.	3,9	230	***-***	***-***
165	******	******	18.0	0.0	**********198.****	1,9	****	***-***	***-***
166	******	******	******	0.0	********** 70.	3,0	****	***-***	***-***

NTB (CONTINUED)

SPOT	DATES OBSVD	LONG	NO.	DRIFT	ROT PERIOD	D,L	S	P	T	LENGTH	DL/L	DEV
167	122 181	340.	15	30.5	9H56M22.4S	1	2	2	2	6.5	0.23	4
168	209 209	****	1	******	*H**M****S	1	2	3	0	5.0	0.0	**
169	166 181	330.	4	40.0	9H56M35.4S	1	1	2	4	9.0	0.0	**
170	130 152	23.	5	30.0	9H56M21.7S	1	1	3	4	7.5	0.20	**
171	121 155	55.	6	27.4	9H56M18.1S	1	1	2	2	8.0	0.0	**
172	121 160	79.	8	23.8	9H56M13.3S	2	3	1	0	8.5	0.53	**
173	121 155	110.	7	20.3	9H56M 8.4S	1	3	2	0	5.0	0.20	**
174	160 184	97.	5	21.2	9H56M 9.7S	2	2	3	0	5.0	0.20	**
175	160 184	100.	6	22.5	9H56M11.4S	1	2	3	0	6.0	0.33	**
176	121 174	115.	11	21.5	9H56M10.1S	2	2	2	0	7.0	0.43	0
177	165 174	126.	4	16.7	9H56M 3.4S	1	1	3	0	5.0	0.0	**
178	121 140	119.	5	34.7	9H56M28.2S	1	1	2	4	8.0	0.13	**
179	121 131	88.	4	63.0	9H57M 6.9S	1	1	2	4	5.0	0.0	**
180	121 184	170.	9	11.4	9H55M56.3S	1	2	0	6	****	****	2
181	140 158	152.	6	30.0	9H56M21.7S	2	2	1	0	10.0	0.10	**
182	114 175	210.	12	22.1	9H56M10.9S	1	1	3	4	9.0	0.44	4
183	104 134	222.	7	28.0	9H56M18.9S	1	1	2	4	9.0	0.0	**
184	120 146	226.	4	31.2	9H56M23.3S	1	2	3	0	4.0	0.25	**
185	144 173	230.	5	25.9	9H56M16.0S	1	2	2	2	7.0	0.14	**
186	139 185	263.	8	23.5	9H56M12.8S	2	2	1	0	17.0	0.12	**
187	132 144	309.	4	12.5	9H55M57.7S	1	1	2	2	4.0	0.0	**
188	103 166	302.	13	19.5	9H56M 7.3S	1	2	0	7	****	****	5
189	193 209	215.	4	20.6	9H56M 8.8S	1	2	3	4	6.0	0.33	**

NTR (CONTINUED)

SPOT	DRIFT1	DRIFT2	DRIFT3	30DEV	LIFETIME (SEE TEXT)	WHY	PART	DATES PROMINENT
167	******	******	******	0.0	********** 59.	0,3	237	***-*** ***-***
168	******	******	******	*****	********** 1.	3,9	237	***-*** ***-***
169	******	******	******	*****	********** 15.	5,5	****	***-*** ***-***
170	******	******	******	*****	********** 22.	4,3	****	***-*** ***-***
171	******	******	******	*****	**** 34.**********	1,0	****	***-*** ***-***
172	******	******	******	*****	**** 39.**********	8,0	****	***-*** ***-***
173	******	******	******	*****	********** 34.	3,4	****	***-*** ***-***
174	******	******	******	*****	******** 48.**********	0,9	****	***-*** ***-***
175	******	******	******	*****	********** 24.	0,3	****	***-*** ***-***
176	******	******	******	0.0	********** 53.	3,3	****	***-*** ***-***
177	******	******	******	*****	********** 9.	1,3	****	***-*** ***-***
178	******	******	******	*****	********** 19.	3,2	****	***-*** ***-***
179	******	******	******	*****	********** 10.	3,3	****	***-*** ***-***
180	******	******	******	0.0	********** 63.	3,3	****	***-*** ***-***
181	******	******	******	*****	********** 18.	3,3	****	***-*** ***-***
182	******	******	******	0.0	********** 61.	3,3	****	***-*** ***-***
183	******	******	******	*****	********** 30.	3,3	****	***-*** ***-***
184	******	******	******	*****	********** 26.	3,0	****	***-*** ***-***
185	******	******	******	*****	********** 29.	7,3	****	***-*** ***-***
186	******	******	******	*****	**** 46.**********	0,1	****	***-*** ***-***
187	******	******	******	*****	********** 12.	2,1	****	***-*** ***-***
188	******	******	******	1.50	**** 63.**********	1,0	****	***-*** ***-***
189	******	******	******	*****	********** 16.	3,9	****	***-*** ***-***

THE NTR CURRENT. NOV 1966-JUNE 1967.

DEFINITE AND PROBABLE SPOTS

SPOT	DATES	OBSVD	LONG	NO.	DRIFT	ROT PERIOD	D,L	S	P	T	LENGTH	DL/L	DEV
101	37	52	60.	6	34.0	9H56M27.2S	1	2	2	2	5.5	0.27	**
102	47	52	43.	3	6.0	9H55M48.8S	1	1	2	2	9.0	0.11	**
103	60	69	72.	4	40.0	9H56M35.4S	1	1	2	2	7.0	0.43	**
104	78	79	59.	2	30.0	9H56M21.7S	1	1	3	2	4.0	0.0	**
105	80	82	63.	2	15.0	9H56M 1.1S	1	2	3	3	3.0	0.0	**
106	72	87	34.	9	22.0	9H56M10.7S	2	2	3	0	6.0	0.17	**
107	88	94	23.	0	20.0	9H56M 8.0S	1	2	0	7	****	****	**
111	46	49	57.	3	10.0	9H55M54.3S	2	1	2	0	6.5	0.23	**
112	28	30	32.	2	0.0	9H55M40.6S	2	1	2	4	6.5	0.23	**
120	6	13	82.	4	17.1	9H56M 4.1S	2	2	0	7	****	****	**
121	11	16	99.	4	30.0	9H56M21.7S	2	1	3	0	5.0	0.20	**
122	1	21	108.	9	19.5	9H56M 7.3S	1	1	3	4	7.5	0.33	**
123	35	65	112.	7	24.0	9H56M13.5S	1	1	2	4	8.0	0.0	**
124	50	77	140.	5	22.2	9H56M11.0S	2	1	1	5	9.5	0.26	**
125	72	82	144.	4	33.0	9H56M25.8S	1	2	2	0	3.5	0.14	**
126	65	96	90.	10	25.2	9H56M15.1S	2	2	3	0	5.5	0.27	**
127	72	104	96.	11	26.2	9H56M16.6S	1	1	3	4	6.5	0.23	**
130	7	96	158.	23	25.6	9H56M15.7S	1	2	3	2	4.5	0.33	2
131	28	110	165.	20	24.1	9H56M13.7S	1	2	3	4	6.0	0.33	2
132	77	90	177.	6	23.1	9H56M12.2S	1	2	3	0	2.5	0.20	**
133	2	28	178.	7	23.1	9H56M12.2S	1	2	2	2	9.0	0.22	**
136	104	175	200.	11	22.0	9H56M10.7S	2	3	1	0	18.0	0.28	0
137	36	95	226.	11	22.9	9H56M11.9S	1	2	2	2	12.5	0.36	4
138	87	95	242.	3	11.2	9H55M56.0S	1	2	2	0	4.5	0.11	**
139	15	19	214.	2	7.5	9H55M50.9S	1	1	3	4	8.0	0.25	**
140	32	32	****	1	******	*H**M****S	1	1	2	4	10.0	0.0	**
143	37	58	265.	6	34.3	9H56M27.6S	1	2	0	7	****	****	**
144	76	202	245.	26	24.0	9H56M13.5S	1	2	3	2	7.5	0.33	3
145	76	80	255.	2	45.0	9H56M42.2S	1	2	2	0	3.0	0.0	**
146	71	134	257.	19	22.4	9H56M11.2S	1	2	2	0	5.5	0.27	2
150	5	225	219.	43	0.0	9H55M40.6S	1	1	2	2	6.0	0.33	4
151	5	39	283.	6	22.1	9H56M10.8S	2	2	2	0	7.5	0.20	**
152	69	105	290.	8	16.7	9H56M 3.4S	1	2	2	0	5.0	0.20	3

NTB (CONTINUED)

SPOT	DRIFT1	DRIFT2	DRIFT3	30DEV	LIFETIME (SEE TEXT)	WHY	PART	DATES PROMINENT	
101	******	******	******	*****	********** 15.	1,3	****	***-***	***-***
102	******	******	******	*****	********** 5.	0,3	****	***-***	***-***
103	******	******	******	*****	********** 9.	3,4	****	***-***	***-***
104	******	******	******	*****	********** 1.	2,2	****	***-***	***-***
105	******	******	******	*****	********** 2.	4,7	****	***-***	***-***
106	******	******	******	*****	17.**********	0,0	****	***-***	***-***
107	******	******	******	*****	**** 6.**********	0,1	****	***-***	***-***
111	******	******	******	*****	********** 3.	1,3	****	***-***	***-***
112	******	******	******	*****	********** 2.	3,2	****	***-***	***-***
120	******	******	******	*****	******** 14.**********	9,0	****	***-***	***-***
121	******	******	******	*****	********** 5.	2,5	****	***-***	***-***
122	******	******	******	*****	********** 20.	9,7	****	***-***	***-***
123	******	******	******	*****	********** 30.	5,5	****	***-***	***-***
124	******	******	******	*****	********** 27.	2,1	****	***-***	***-***
125	******	******	******	*****	********** 10.	1,3	****	***-***	***-***
126	******	******	******	*****	**** 31.**********	0,1	****	***-***	***-***
127	******	******	******	*****	********** 32.	8,3	****	***-***	***-***
130	25.0	******	******	2.00	*********178.**********	9,0	****	***-***	***-***
131	******	******	******	1.50	********** 82.	1,1	****	***-***	***-***
132	******	******	******	*****	********** 13.	2,1	****	***-***	***-***
133	******	******	******	*****	********** 26.	9,5	****	***-***	***-***
136	******	******	******	4.50	********** 71.	8,3	****	126-141	***-***
137	******	******	******	0.0	********** 59.	1,3	****	64- 91	***-***
138	******	******	******	*****	********** 8.	0,3	****	***-***	***-***
139	******	******	******	*****	********** 4.	1,3	234	***-***	***-***
140	******	******	******	*****	********** 1.	3,0	234	***-***	***-***
143	******	******	******	*****	********** 21.********	1,8	****	***-***	***-***
144	******	******	22.0	0.44	********252.**********	0,9	****	105-173	***-***
145	******	******	******	*****	********** 4.	2,2	****	***-***	***-***
146	******	******	******	0.0	**** 63.**********	1,0	****	***-***	***-***
150	22.5	24.0	20.5	2.78	**********220.	9,9	****	***-***	***-***
151	******	******	******	*****	********** 68.****	9,1	****	***-***	***-***
152	******	******	******	0.0	********** 36.	1,1	****	***-***	***-***

NTB (CONTINUED)

SPOT	DATES OBSVD		LONG	NO.	DRIFT	ROT PERIOD	D,L	S	P	T	LENGTH	DL/L	DEV
153	37	88	313.	14	25.3	9H56M15.2S	1	1	2	2	8.5	0.29	3
154	69	73	336.	3	30.0	9H56M21.7S	1	2	3	2	2.5	0.20	**
155	64	202	327.	36	0.0	9H55M40.6S	1	3	2	2	6.5	0.23	4
156	64	134	341.	24	0.0	9H55M40.6S	1	1	2	2	6.5	0.23	4
157	1	16	354.	3	12.0	9H55M57.0S	1	1	2	4	11.0	0.09	**
158	30	43	357.	3	13.8	9H55M59.6S	1	1	3	4	10.0	0.30	**
159	64	105	355.	19	0.0	9H55M40.6S	1	2	2	4	8.0	0.13	5
160	1	79	348.	24	0.0	9H55M40.6S	1	2	0	7	****	****	5
161	15	20	285.	2	30.0	9H56M21.7S	2	3	1	0	11.5	0.04	**
162	115	152	4.	14	30.8	9H56M22.8S	1	2	2	0	6.0	0.17	**
165	113	212	351.	25	0.0	9H55M40.6S	1	3	3	2	6.0	0.17	2
166	113	183	339.	17	0.0	9H55M40.6S	1	2	2	4	9.0	0.11	0
167	122	181	340.	15	30.5	9H56M22.4S	1	2	2	2	6.5	0.23	4
168	209	209	****	1	******	*H**M****S	1	2	3	0	5.0	0.0	**
169	166	181	330.	4	40.0	9H56M35.4S	1	1	2	4	9.0	0.0	**
170	130	152	23.	5	30.0	9H56M21.7S	1	1	3	4	7.5	0.20	**
171	121	155	55.	6	27.4	9H56M18.1S	1	1	2	2	8.0	0.0	**
172	121	160	79.	8	23.8	9H56M13.3S	2	3	1	0	8.5	0.53	**
173	121	155	110.	7	20.3	9H56M 8.4S	1	3	2	0	5.0	0.20	**
174	160	184	97.	5	21.2	9H56M 9.7S	2	2	3	0	5.0	0.20	**
175	160	184	100.	6	22.5	9H56M11.4S	1	2	3	0	6.0	0.33	**
176	121	174	115.	11	21.5	9H56M10.1S	2	2	2	0	7.0	0.43	0
177	165	174	126.	4	16.7	9H56M 3.4S	1	1	3	0	5.0	0.0	**
178	121	140	119.	5	34.7	9H56M28.2S	1	1	2	4	8.0	0.13	**
179	121	131	88.	4	63.0	9H57M 6.9S	1	1	2	4	5.0	0.0	**
180	121	184	170.	9	11.4	9H55M56.3S	1	2	0	6	****	****	2
181	140	158	152.	6	30.0	9H56M21.7S	2	2	1	0	10.0	0.10	**
182	114	175	210.	12	22.1	9H56M10.9S	1	1	3	4	9.0	0.44	4
183	104	134	222.	7	28.0	9H56M18.9S	1	1	2	4	9.0	0.0	**
184	120	146	226.	4	31.2	9H56M23.3S	1	2	3	0	4.0	0.25	**
185	144	173	230.	5	25.9	9H56M16.0S	1	2	2	2	7.0	0.14	**
186	139	185	263.	8	23.5	9H56M12.8S	2	2	1	0	17.0	0.12	**
187	132	144	309.	4	12.5	9H55M57.7S	1	1	2	2	4.0	0.0	**

NTB (CONTINUED)

SPOT	DRIFT1	DRIFT2	DRIFT3	3ODEV	LIFETIME (SEE TEXT)	WHY	PART	DATES PROMINENT	
153	******	******	******	0.0	********** 51.	1,1	****	***-***	***-***
154	******	******	******	*****	********** 4.	2,2	****	***-***	***-***
155	******	23.0	18.0	2.75	********276.**********	0,9	****	91-152	***-***
156	******	******	******	0.0	********** 70.	0,4	****	***-***	***-***
157	******	******	******	*****	********** 15.	9,3	235	***-***	***-***
158	******	******	******	*****	********** 13.	3,2	236	***-***	***-***
159	******	******	******	0.0	********** 41.	2,7	236	***-***	***-***
160	15.0	******	******	4.00	********156.**********	9,0	****	***-***	***-***
161	******	******	******	*****	********** 5.	1,3	****	***-***	***-***
162	******	******	******	*****	**** 37.**********	0,1	****	***-***	***-***
165	******	******	18.0	0.0	**********198.****	1,9	****	***-***	***-***
166	******	******	******	0.0	********** 70.	3,0	****	***-***	***-***
167	******	******	******	0.0	********** 59.	0,3	237	***-***	***-***
168	******	******	******	*****	********** 1.	3,9	237	***-***	***-***
169	******	******	******	*****	********** 15.	5,5	****	***-***	***-***
170	******	******	******	*****	********** 22.	4,3	****	***-***	***-***
171	******	******	******	*****	**** 34.**********	1,0	****	***-***	***-***
172	******	******	******	*****	**** 39.**********	8,0	****	***-***	***-***
173	******	******	******	*****	********** 34.	3,4	****	***-***	***-***
174	******	******	******	*****	******** 48.**********	0,9	****	***-***	***-***
175	******	******	******	*****	********** 24.	0,3	****	***-***	***-***
176	******	******	******	0.0	********** 53.	3,3	****	***-***	***-***
177	******	******	******	*****	********** 9.	1,3	****	***-***	***-***
178	******	******	******	*****	********** 19.	3,2	****	***-***	***-***
179	******	******	******	*****	********** 10.	3,3	****	***-***	***-***
180	******	******	******	0.0	********** 63.	3,3	****	***-***	***-***
181	******	******	******	*****	********** 18.	3,3	****	***-***	***-***
182	******	******	******	0.0	********** 61.	3,3	****	***-***	***-***
183	******	******	******	*****	********** 30.	3,3	****	***-***	***-***
184	******	******	******	*****	********** 26.	3,0	****	***-***	***-***
185	******	******	******	*****	********** 29.	7,3	****	***-***	***-***
186	******	******	******	*****	**** 46.**********	0,1	****	***-***	***-***
187	******	******	******	*****	********** 12.	2,1	****	***-***	***-***

NTB (CONTINUED)

SPOT	DATES OBSVD	LONG	NO.	DRIFT	ROT PERIOD	D,L	S	P	T	LENGTH	DL/L	DEV
188	103 166	302.	13	19.5	9H56M 7.3S	1	2	0	7	****	****	5
189	193 209	215.	4	20.6	9H56M 8.8S	1	2	3	4	6.0	0.33	**
223	87 196	41.	20	30.8	9H56M22.8S	2	2	0	0	****	****	2
224	6 49	74.	17	20.9	9H56M 9.3S	1	2	0	2	****	****	**
225	58 186	82.	28	22.7	9H56M11.7S	1	2	0	2	****	****	2
226	79 160	67.	17	28.1	9H56M19.1S	1	2	1	3	4.5	0.11	**
227	65 175	188.	13	21.8	9H56M10.5S	2	3	1	6	****	0.0	2
228	5 19	261.	3	23.6	9H56M12.9S	1	2	1	2	3.5	0.14	**
229	49 110	265.	14	24.6	9H56M14.3S	2	2	1	0	6.0	0.33	**
230	127 188	348.	9	17.2	9H56M 4.2S	2	1	1	0	7.5	0.33	**

NTB (CONTINUED)

SPOT	DRIFT1	DRIFT2	DRIFT3	30DEV	LIFETIME (SEE TEXT)	WHY	PART	DATES PROMINENT	
188	******	******	******	1.50	**** 63.**********	1,0	****	***-***	***-***
189	******	******	******	*****	********** 16.	3,9	****	***-***	***-***
223	******	******	32.0	3.11	********218.**********	0,9	****	***-***	***-***
224	******	******	******	0.0	********** 43.	9,3	****	***-***	***-***
225	******	25.5	******	1.11	**********128.	3,3	****	***-***	***-***
226	******	******	******	0.0	********** 81.	4,3	****	***-***	***-***
227	******	18.0	******	3.11	**********110.	3,3	****	***-***	***-***
228	******	******	******	*****	********** 14.	9,5	****	***-***	***-***
229	******	******	******	0.0	********** 61.	1,1	****	***-***	***-***
230	******	******	******	0.0	**********122.****	8,9	****	***-***	***-***

THE NTB CURRENT. NOV 1966-JUNE 1967.

DEFINITE, PROBABLE, AND POSSIBLE SPOTS

SPOT	DATES OBSVD		LONG	NO.	DRIFT	ROT PERIOD	D,L	S	P	T	LENGTH	DL/L	DEV
101	37	52	60.	6	34.0	9H56M27.2S	1	2	2	2	5.5	0.27	**
102	47	52	43.	3	6.0	9H55M48.8S	1	1	2	2	9.0	0.11	**
103	60	69	72.	4	40.0	9H56M35.4S	1	1	2	2	7.0	0.43	**
104	78	79	59.	2	30.0	9H56M21.7S	1	1	3	2	4.0	0.0	**
105	80	82	63.	2	15.0	9H56M 1.1S	1	2	3	3	3.0	0.0	**
106	72	87	34.	9	22.0	9H56M10.7S	2	2	3	0	6.0	0.17	**
107	88	94	23.	0	20.0	9H56M 8.0S	1	2	0	7	****	****	**
111	46	49	57.	3	10.0	9H55M54.3S	2	1	2	0	6.5	0.23	**
112	28	30	32.	2	0.0	9H55M40.6S	2	1	2	4	6.5	0.23	**
120	6	13	82.	4	17.1	9H56M 4.1S	2	2	0	7	****	****	**
121	11	16	99.	4	30.0	9H56M21.7S	2	1	3	0	5.0	0.20	**
122	1	21	108.	9	19.5	9H56M 7.3S	1	1	3	4	7.5	0.33	**
123	35	65	112.	7	24.0	9H56M13.5S	1	1	2	4	8.0	0.0	**
124	50	77	140.	5	22.2	9H56M11.0S	2	1	1	5	9.5	0.26	**
125	72	82	144.	4	33.0	9H56M25.8S	1	2	2	0	3.5	0.14	**
126	65	96	90.	10	25.2	9H56M15.1S	2	2	3	0	5.5	0.27	**
127	72	104	96.	11	26.2	9H56M16.6S	1	1	3	4	6.5	0.23	**
130	7	96	158.	23	25.6	9H56M15.7S	1	2	3	2	4.5	0.33	2
131	28	110	165.	20	24.1	9H56M13.7S	1	2	3	4	6.0	0.33	2
132	77	90	177.	6	23.1	9H56M12.2S	1	2	3	0	2.5	0.20	**
133	2	28	178.	7	23.1	9H56M12.2S	1	2	2	2	9.0	0.22	**
136	104	175	200.	11	22.0	9H56M10.7S	2	3	1	0	18.0	0.28	0
137	36	95	226.	11	22.9	9H56M11.9S	1	2	2	2	12.5	0.36	4
138	87	95	242.	3	11.2	9H55M56.0S	1	2	2	0	4.5	0.11	**
143	37	58	265.	6	34.3	9H56M27.6S	1	2	0	7	****	****	**
144	76	202	245.	26	24.0	9H56M13.5S	1	2	3	2	7.5	0.33	3
145	76	80	255.	2	45.0	9H56M42.2S	1	2	2	0	3.0	0.0	**
146	71	134	257.	19	22.4	9H56M11.2S	1	2	2	0	5.5	0.27	2
150	5	225	219.	43	0.0	9H55M40.6S	1	1	2	2	6.0	0.33	4
151	5	39	283.	6	22.1	9H56M10.8S	2	2	2	0	7.5	0.20	**
152	69	105	290.	8	16.7	9H56M 3.4S	1	2	2	0	5.0	0.20	3
153	37	88	313.	14	25.3	9H56M15.2S	1	1	2	2	8.5	0.29	3
154	69	73	336.	3	30.0	9H56M21.7S	1	2	3	2	2.5	0.20	**

NTB (CONTINUED)

SPOT	DRIFT1	DRIFT2	DRIFT3	30DEV	LIFETIME (SEE TEXT)	WHY	PART	DATES PROMINENT	
101	******	******	******	*****	********** 15.	1,3	****	***-***	***-***
102	******	******	******	*****	********** 5.	0,3	****	***-***	***-***
103	******	******	******	*****	********** 9.	3,4	****	***-***	***-***
104	******	******	******	*****	********** 1.	2,2	****	***-***	***-***
105	******	******	******	*****	********** 2.	4,7	****	***-***	***-***
106	******	******	******	*****	17.**********	0,0	****	***-***	***-***
107	******	******	******	*****	**** 6.**********	0,1	****	***-***	***-***
111	******	******	******	*****	********** 3.	1,3	****	***-***	***-***
112	******	******	******	*****	********** 2.	3,2	****	***-***	***-***
120	******	******	******	*****	******** 14.**********	9,0	****	***-***	***-***
121	******	******	******	*****	********** 5.	2,5	****	***-***	***-***
122	******	******	******	*****	********** 20.	9,7	****	***-***	***-***
123	******	******	******	*****	********** 30.	5,5	****	***-***	***-***
124	******	******	******	*****	********** 27.	2,1	****	***-***	***-***
125	******	******	******	*****	********** 10.	1,3	****	***-***	***-***
126	******	******	******	*****	**** 31.**********	0,1	****	***-***	***-***
127	******	******	******	*****	********** 32.	8,3	****	***-***	***-***
130	25.0	******	******	2.00	********178.**********	9,0	****	***-***	***-***
131	******	******	******	1.50	********** 82.	1,1	****	***-***	***-***
132	******	******	******	*****	********** 13.	2,1	****	***-***	***-***
133	******	******	******	*****	********** 26.	9,5	****	***-***	***-***
136	******	******	******	4.50	********** 71.	8,3	****	126-141	***-***
137	******	******	******	0.0	********** 59.	1,3	****	64- 91	***-***
138	******	******	******	*****	********** 8.	0,3	****	***-***	***-***
143	******	******	******	*****	********** 21.********	1,8	****	***-***	***-***
144	******	******	22.0	0.44	********252.**********	0,9	****	105-173	***-***
145	******	******	******	*****	********** 4.	2,2	****	***-***	***-***
146	******	******	******	0.0	**** 63.**********	1,0	****	***-***	***-***
150	22.5	24.0	20.5	2.78	**********220.	9,9	****	***-***	***-***
151	******	******	******	*****	********** 68.****	9,1	****	***-***	***-***
152	******	******	******	0.0	********** 36.	1,1	****	***-***	***-***
153	******	******	******	0.0	********** 51.	1,1	****	***-***	***-***
154	******	******	******	*****	********** 4.	2,2	****	***-***	***-***

NTB (CONTINUED)

SPOT	DATES OBSVD	LONG	NO.	DRIFT	ROT PERIOD	D,L	S	P	T	LENGTH	DL/L	DEV
155	64 202	327.	36	0.0	9H55M40.6S	1	3	2	2	6.5	0.23	4
156	64 134	341.	24	0.0	9H55M40.6S	1	1	2	2	6.5	0.23	4
160	1 79	348.	24	0.0	9H55M40.6S	1	2	0	7	****	****	5
161	15 20	285.	2	30.0	9H56M21.7S	2	3	1	0	11.5	0.04	**
162	115 152	4.	14	30.8	9H56M22.8S	1	2	2	0	6.0	0.17	**
165	113 212	351.	25	0.0	9H55M40.6S	1	3	3	2	6.0	0.17	2
166	113 183	339.	17	0.0	9H55M40.6S	1	2	2	4	9.0	0.11	0
169	166 181	330.	4	40.0	9H56M35.4S	1	1	2	4	9.0	0.0	**
170	130 152	23.	5	30.0	9H56M21.7S	1	1	3	4	7.5	0.20	**
171	121 155	55.	6	27.4	9H56M18.1S	1	1	2	2	8.0	0.0	**
172	121 160	79.	8	23.8	9H56M13.3S	2	3	1	0	8.5	0.53	**
173	121 155	110.	7	20.3	9H56M 8.4S	1	3	2	0	5.0	0.20	**
174	160 184	97.	5	21.2	9H56M 9.7S	2	2	3	0	5.0	0.20	**
175	160 184	100.	6	22.5	9H56M11.4S	1	2	3	0	6.0	0.33	**
176	121 174	115.	11	21.5	9H56M10.1S	2	2	2	0	7.0	0.43	0
177	165 174	126.	4	16.7	9H56M 3.4S	1	1	3	0	5.0	0.0	**
178	121 140	119.	5	34.7	9H56M28.2S	1	1	2	4	8.0	0.13	**
179	121 131	88.	4	63.0	9H57M 6.9S	1	1	2	4	5.0	0.0	**
180	121 184	170.	9	11.4	9H55M56.3S	1	2	0	6	****	****	2
181	140 158	152.	6	30.0	9H56M21.7S	2	2	1	0	10.0	0.10	**
182	114 175	210.	12	22.1	9H56M10.9S	1	1	3	4	9.0	0.44	4
183	104 134	222.	7	28.0	9H56M18.9S	1	1	2	4	9.0	0.0	**
184	120 146	226.	4	31.2	9H56M23.3S	1	2	3	0	4.0	0.25	**
185	144 173	230.	5	25.9	9H56M16.0S	1	2	2	2	7.0	0.14	**
186	139 185	263.	8	23.5	9H56M12.8S	2	2	1	0	17.0	0.12	**
187	132 144	309.	4	12.5	9H55M57.7S	1	1	2	2	4.0	0.0	**
188	103 166	302.	13	19.5	9H56M 7.3S	1	2	0	7	****	****	5
189	193 209	215.	4	20.6	9H56M 8.8S	1	2	3	4	6.0	0.33	**
223	87 196	41.	20	30.8	9H56M22.8S	2	2	0	0	****	****	2
224	6 49	74.	17	20.9	9H56M 9.3S	1	2	0	2	****	****	**
225	58 186	82.	28	22.7	9H56M11.7S	1	2	0	2	****	****	2
226	79 160	67.	17	28.1	9H56M19.1S	1	2	1	3	4.5	0.11	**
227	65 175	188.	13	21.8	9H56M10.5S	2	3	1	6	****	0.0	2

NTB (CONTINUED)

SPOT	DRIFT1.	DRIFT2	DRIFT3	30DEV	LIFETIME (SEE TEXT)	WHY	PART	DATES PROMINENT
155	******	23.0	18.0	2.75	********276.**********	0,9	****	91-152. ***-***
156	******	******	******	0.0	********** 70.	0,4	****	***-*** ***-***
160	15.0	******	******	4.00	********156.**********	9,0	****	***-*** ***-***
161	******	******	******	*****	********** 5.	1,3	****	***-*** ***-***
162	******	******	******	*****	**** 37.**********	0,1	****	***-*** ***-***
165	******	******	18.0	0.0	**********198.****	1,9	****	***-*** ***-***
166	******	******	******	0.0	********** 70.	3,0	****	***-*** ***-***
169	******	******	******	*****	********** 15.	5,5	****	***-*** ***-***
170	******	******	******	*****	********** 22.	4,3	****	***-*** ***-***
171	******	******	******	*****	**** 34.**********	1,0	****	***-*** ***-***
172	******	******	******	*****	**** 39.**********	8,0	****	***-*** ***-***
173	******	******	******	*****	********** 34.	3,4	****	***-*** ***-***
174	******	******	******	*****	******** 48.**********	0,9	****	***-*** ***-***
175	******	******	******	*****	********** 24.	0,3	****	***-*** ***-***
176	******	******	******	0.0	********** 53.	3,3	****	***-*** ***-***
177	******	******	******	*****	********** 9.	1,3	****	***-*** ***-***
178	******	******	******	*****	********** 19.	3,2	****	***-*** ***-***
179	******	******	******	*****	********** 10.	3,3	****	***-*** ***-***
180	******	******	******	0.0	********** 63.	3,3	****	***-*** ***-***
181	******	******	******	*****	********** 18.	3,3	****	***-*** ***-***
182	******	******	******	0.0	********** 61.	3,3	****	***-*** ***-***
183	******	******	******	*****	********** 30.	3,3	****	***-*** ***-***
184	******	******	******	*****	********** 26.	3,0	****	***-*** ***-***
185	******	******	******	*****	********** 29.	7,3	****	***-*** ***-***
186	******	******	******	*****	**** 46.**********	0,1	****	***-*** ***-***
187	******	******	******	*****	********** 12.	2,1	****	***-*** ***-***
188	******	******	******	1.50	**** 63.**********	1,0	****	***-*** ***-***
189	******	******	******	*****	********** 16.	3,9	****	***-*** ***-***
223	******	******	32.0	3.11	********218.**********	0,9	****	***-*** ***-***
224	******	******	******	0.0	********** 43.	9,3	****	***-*** ***-***
225	******	25.5	******	1.11	**********128.	3,3	****	***-*** ***-***
226	******	******	******	0.0	********** 81.	4,3	****	***-*** ***-***
227	******	18.0	******	3.11	**********110.	3,3	****	***-*** ***-***

NTB (CONTINUED)

SPOT	DATES OBSVD	LONG	NC.	DRIFT	ROT PERIOD	D,L	S	P	T	LENGTH	DL/L	DEV
228	5 19	261.	3	23.6	9H56M12.9S	1	2	1	2	3.5	0.14	**
229	49 110	265.	14	24.6	9H56M14.3S	2	2	1	0	6.0	0.33	**
230	127 188	348.	9	17.2	9H56M 4.2S	2	1	1	0	7.5	0.33	**
234	15 32	236.	3	17.6	9H56M 4.8S	1	1	1	4	8.0	0.25	**
235	1 43	356.	6	12.9	9H55M58.2S	1	1	1	4	10.0	0.30	**
236	30 105	334.	22	0.0	9H55M40.6S	1	1	1	4	10.0	0.30	5
237	122 209	340.	16	30.7	9H56M22.6S	1	2	1	2	6.5	0.23	4

NTB (CONTINUED)

SPOT	DRIFT1	DRIFT2	DRIFT3	3 ODEV	LIFETIME (SEE TEXT)	WHY	PART	DATES	PROMINENT
228	******	******	******	*****	********** 14.	9,5	****	***-***	***-***
229	******	******	******	0.0	********** 61.	1,1	****	***-***	***-***
230	******	******	******	0.0	**********122.****	8,9	****	***-***	***-***
234	******	******	******	*****	********** 17.********	1,0	****	***-***	***-***
235	******	******	******	0.0	********** 42.	9,2	****	***-***	***-***
236	******	******	******	2.50	********** 75.	3,7	****	***-***	***-***
237	******	******	29.0	1.00	**********174.********	0,9	****	***-***	***-***

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DEFINITE SPOTS

SPOT	DATES OBSVD		LONG	NO.	DRIFT	ROT PERIOD	D,L	S	P	T	LENGTH	DL/L	DEV
191	17	21	24.	3	-22.5	9H55M 9.8S	1	1	4	1	3.5	0.14	**
192	3	208	163.	31	-1.9	9H55M38.0S	1	3	1	0	10.5	0.33	6
193	88	182	295.	16	-7.3	9H55M30.6S	1	2	2	0	8.0	0.13	4
194	104	190	36.	20	0.0	9H55M40.6S	1	1	2	0	9.0	0.11	0
195	126	130	159.	3	-22.5	9H55M 9.8S	1	1	4	1	5.0	0.0	**
196	127	145	322.	4	11.7	9H55M56.6S	1	2	0	6	****	****	**
197	2	12	144.	4	0.0	9H55M40.6S	1	2	2	0	6.0	0.0	**
198	13	158	0.	24	-6.6	9H55M31.6S	2	3	2	0	5.0	0.20	3
199	28	31	103.	2	10.0	9H55M54.3S	2	2	3	0	3.0	0.0	**
200	130	159	358.	5	10.3	9H55M54.8S	1	2	3	4	4.0	0.0	**
201	123	152	26.	5	1.0	9H55M42.0S	2	2	2	0	6.0	0.0	**
202	104	161	39.	10	2.6	9H55M44.2S	2	1	2	0	7.0	0.14	4
203	83	96	77.	3	-6.9	9H55M31.1S	2	2	2	0	4.0	0.25	**
204	105	158	302.	9	-7.9	9H55M29.8S	2	1	3	0	6.0	0.17	5
205	103	151	14.	9	-8.1	9H55M29.5S	1	2	3	4	8.0	0.25	2

NNTBS (CONTINUED)

SPOT	DRIFT1	DRIFT2	DRIFT3	30DEV	LIFETIME (SEE TEXT)	WHY	PART	DATES PROMINENT	
191	******	******	******	*****	********** 4.	1,1	****	***-***	***-***
192	-10.5	-4.0	4.5	5.22	**********205.	9,9	****	104-150	***-***
193	******	******	******	1.00	**********188.****	1,9	****	***-***	***-***
194	******	******	******	1.00	**********172.****	1,9	****	***-***	***-***
195	******	******	******	*****	********** 4.	3,3	****	***-***	***-***
196	******	******	******	*****	********** 18.	1,1	****	***-***	***-***
197	******	******	******	*****	********** 10.	9,2	****	***-***	***-***
198	-5.0	-6.0	******	1.00	**********145.	2,2	****	***-***	***-***
199	******	******	******	*****	********** 3.	2,2	****	***-***	***-***
200	******	******	******	*****	********** 29.	1,2	****	***-***	***-***
201	******	******	******	*****	********** 29.	2,2	****	***-***	***-***
202	******	******	******	0.0	********** 57.	5,2	****	***-***	***-***
203	******	******	******	*****	********** 13.	2,1	****	***-***	***-***
204	******	******	******	0.0	********** 53.	2,2	****	***-***	***-***
205	******	******	******	0.0	********** 48.	1,3	****	***-***	***-***

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DEFINITE SPOTS

SPOT	DATES OBSVD		LONG	NO.	DRIFT	ROT PERIOD	D,L	S	P	T	LENGTH	DL/L	DEV
206	58	77	131.	3	-7.9	9H55M29.8S	1	1	0	6	****	****	**
207	19	28	76.	3	-6.7	9H55M31.5S	1	1	0	7	****	****	**
208	83	140	99.	8	-5.8	9H55M32.7S	1	2	0	6	****	****	0
209	121	174	173.	6	-17.5	9H55M16.6S	2	1	2	0	5.0	0.0	5
210	132	144	271.	4	-10.0	9H55M26.9S	1	2	2	4	8.0	0.13	**

NNTEZ (CONTINUED)

SPOT	DRIFT1	DRIFT2	DRIFT3	30DEV	LIFETIME (SEE TEXT)		WHY	PART	DATES PROMINENT	
206	******	******	******	*****	**********	19.	2,2	****	***-***	***-***
207	******	******	******	*****	**********	9.	2,2	****	***-***	***-***
208	******	******	******	0.0	**********	57.	2,2	****	***-***	***-***
209	******	******	******	0.0	**********	53.	2,2	****	***-***	***-***
210	******	******	******	*****	**********	12.	2,2	****	***-***	***-***

APPENDIX C

Relationships Between Spot Characteristics

DARK SPOTS

MEAN LONG-TERM DEVIATIONS FROM MEAN DRIFTS= 2.12 N= 16.
MEAN SHORT-TERM DEVIATIONS (DEG.) FROM MEAN POSITIONS= ***** N= 32.
MEAN OF DEFINITE OR PROBABLE LIFETIMES= 103.4 DAYS N= 19.
MEAN PROPORTION= 2.5 N= 78.
MEAN LENGTH= 6.4 N= 78.
MEAN RATIO OF LENGTH-DEVIATION TO LENGTH= 0.16 N= 78.
MEAN SIGNED DEVIATION OF DRIFT FROM CURRENT MEAN (NEG=SLOW) 1.41 N= 67.
NUMBER OF DARK SPOTS= 93
NUMBER OF LIGHT SPOTS= 0

DISTRIBUTION OF SPOTS BY TYPE

TYPE	OVAL	SLANT	FESTOON	WAVE	ANGULAR	AMORPHOUS	VARIABLE	PREC. END	FOL. END
NUMBER	22		4	21	4	31	0	5	6

LIGHT SPOTS

MEAN LONG-TERM DEVIATIONS FROM MEAN DRIFTS= 1.98 N= 14.
MEAN SHORT-TERM DEVIATIONS (DEG.) FROM MEAN POSITIONS= ***** N= 27.
MEAN OF DEFINITE OR PROBABLE LIFETIMES= 93.0 DAYS N= 13.
MEAN PROPORTION= 2.1 N= 85.
MEAN LENGTH= **** N= 85.
MEAN RATIO OF LENGTH-DEVIATION TO LENGTH= 0.17 N= 85.
MEAN SIGNED DEVIATION OF DRIFT FROM CURRENT MEAN (NEG=SLOW) -2.05 N= 46.
NUMBER OF DARK SPOTS= 0
NUMBER OF LIGHT SPOTS= 87

DISTRIBUTION OF SPOTS BY TYPE

TYPE	OVAL	SLANT	FESTOON	WAVE	ANGULAR	AMORPHOUS	VARIABLE	PREC. END	FOL. END
NUMBER	65		0	2	0	14	4	1	1

SPOTS OVER 10 DEG LONG

MEAN LONG-TERM DEVIATIONS FROM MEAN DRIFTS= 3.36 N= 6.
MEAN SHORT-TERM DEVIATIONS (DEG.) FROM MEAN POSITIONS= 2.57 N= 7.
MEAN OF DEFINITE OR PROBABLE LIFETIMES= 170.0 DAYS N= 3.
MEAN PROPORTION= 1.3 N= 12.
MEAN LENGTH= **** N= 12.
MEAN RATIO OF LENGTH-DEVIATION TO LENGTH= 0.18 N= 12.
MEAN SIGNED DEVIATION OF DRIFT FROM CURRENT MEAN (NEG=SLOW) -0.36 N= 10.
NUMBER OF DARK SPOTS= 5
NUMBER OF LIGHT SPOTS= 7

DISTRIBUTION OF SPOTS BY TYPE

TYPE	OVAL	SLANT	FESTOON	WAVE	ANGULAR	AMORPHOUS	VARIABLE	PREC. END	FOL. END
NUMBER	6		0	1	0	4	0	1	0

SPOTS 5 TO 10 DEG LONG

MEAN LONG-TERM DEVIATIONS FROM MEAN DRIFTS= 1.53 N= 15.
MEAN SHORT-TERM DEVIATIONS (DEG.) FROM MEAN POSITIONS= ***** N= 36.
MEAN OF DEFINITE OR PROBABLE LIFETIMES= 90.4 DAYS N= 18.
MEAN PROPORTION= 2.2 N=101.
MEAN LENGTH= 6.8 N=101.
MEAN RATIO OF LENGTH-DEVIATION TO LENGTH= 0.18 N=101.
MEAN SIGNED DEVIATION OF DRIFT FROM CURRENT MEAN (NEG=SLOW) -0.12 N= 71.
NUMBER OF DARK SPOTS= 52
NUMBER OF LIGHT SPOTS= 49

DISTRIBUTION OF SPOTS BY TYPE

TYPE	OVAL	SLANT	FESTOON	WAVE	ANGULAR	AMORPHOUS	VARIABLE	PREC. END	FOL. END
NUMBER	51		1	15	0	31	3	0	0

SPOTS LESS THAN 5 DEG LONG

MEAN LONG-TERM DEVIATIONS FROM MEAN DRIFTS= 1.76 N= 5.
MEAN SHORT-TERM DEVIATIONS (DEG.) FROM MEAN POSITIONS= ***** N= 9.
MEAN OF DEFINITE OR PROBABLE LIFETIMES= 130.9 DAYS N= 4.
MEAN PROPORTION= 2.7 N= 50.
MEAN LENGTH= 3.4 N= 50.
MEAN RATIO OF LENGTH-DEVIATION TO LENGTH= 0.12 N= 50.
MEAN SIGNED DEVIATION OF DRIFT FROM CURRENT MEAN (NEG=SLOW) -2.22 N= 18.
NUMBER OF DARK SPOTS= 21
NUMBER OF LIGHT SPOTS= 29

DISTRIBUTION OF SPOTS BY TYPE

TYPE	OVAL	SLANT	FESTOON	WAVE	ANGULAR	AMORPHOUS	VARIABLE	PREC. END	FOL. END
NUMBER	28	3		5	4	9	1	0	0

TALL SPOTS

MEAN LONG-TERM DEVIATIONS FROM MEAN DRIFTS= ***** N= 0.
MEAN SHORT-TERM DEVIATIONS (DEG.) FROM MEAN POSITIONS= ***** N= 0.
MEAN OF DEFINITE OR PROBABLE LIFETIMES= ***** DAYS N= 0.
MEAN PROPORTION= 4.0 N= 5.
MEAN LENGTH= 3.7 N= 5.
MEAN RATIO OF LENGTH-DEVIATION TO LENGTH= 0.03 N= 5.
MEAN SIGNED DEVIATION OF DRIFT FROM CURRENT MEAN (NEG=SLOW) ***** N= 0.
NUMBER OF DARK SPOTS= 5
NUMBER OF LIGHT SPOTS= 0

DISTRIBUTION OF SPOTS BY TYPE

TYPE	OVAL	SLANT	FESTOON	WAVE	ANGULAR	AMORPHOUS	VARIABLE	PREC. END	FOL. END
NUMBER	0	4		0	0	1	0	0	0

ROUND SPOTS

MEAN LONG-TERM DEVIATIONS FROM MEAN DRIFTS= 1.46 N= 9.
MEAN SHORT-TERM DEVIATIONS (DEG.) FROM MEAN POSITIONS= 2.44 N= 16.
MEAN OF DEFINITE OR PROBABLE LIFETIMES= 115.0 DAYS N= 11.
MEAN PROPORTION= 3.0 N= 59.
MEAN LENGTH= 4.9 N= 59.
MEAN RATIO OF LENGTH-DEVIATION TO LENGTH= 0.16 N= 59.
MEAN SIGNED DEVIATION OF DRIFT FROM CURRENT MEAN (NEG=SLOW) -0.39 N= 30.
NUMBER OF DARK SPOTS= 29
NUMBER OF LIGHT SPOTS= 30

DISTRIBUTION OF SPOTS BY TYPE

TYPE	OVAL	SLANT	FESTOON	WAVE	ANGULAR	AMORPHOUS	VARIABLE	PREC. END	FOL. END
NUMBER	33		0	5	3	17	1	0	0

LONG SPOTS

MEAN LONG-TERM DEVIATIONS FROM MEAN DRIFTS= 1.92 N= 10.
MEAN SHORT-TERM DEVIATIONS (DEG.) FROM MEAN POSITIONS= 2.78 N= 23.
MEAN OF DEFINITE OR PROBABLE LIFETIMES= 109.2 DAYS N= 12.
MEAN PROPORTION= 2.0 N= 73.
MEAN LENGTH= 6.6 N= 73.
MEAN RATIO OF LENGTH-DEVIATION TO LENGTH= 0.15 N= 73.
MEAN SIGNED DEVIATION OF DRIFT FROM CURRENT MEAN (NEG=SLOW) 1.07 N= 45.
NUMBER OF DARK SPOTS= 41
NUMBER OF LIGHT SPOTS= 32

DISTRIBUTION OF SPOTS BY TYPE

TYPE	OVAL	SLANT	FESTOON	WAVE	ANGULAR	AMORPHOUS	VARIABLE	PREC. END	FOL. END
NUMBER	38		0	14	0	20	1	0	0

VERY LONG SPOTS

MEAN LONG-TERM DEVIATIONS FROM MEAN DRIFTS= 2.79 N= 7.
MEAN SHORT-TERM DEVIATIONS (DEG.) FROM MEAN POSITIONS= ***** N= 13.
MEAN OF DEFINITE OR PROBABLE LIFETIMES= 42.5 DAYS N= 2.
MEAN PROPORTION= 1.0 N= 26.
MEAN LENGTH= **** N= 26.
MEAN RATIO OF LENGTH-DEVIATION TO LENGTH= 0.24 N= 26.
MEAN SIGNED DEVIATION OF DRIFT FROM CURRENT MEAN (NEG=SLOW) -3.68 N= 24.
NUMBER OF DARK SPOTS= 3
NUMBER OF LIGHT SPOTS= 23

DISTRIBUTION OF SPOTS BY TYPE

TYPE	OVAL	SLANT	FESTOON	WAVE	ANGULAR	AMORPHOUS	VARIABLE	PREC. END	FOL. END
NUMBER	14		0	2	1	6	2	1	0

SPOTS ROTATING SLOWER THAN CURRENT

MEAN LONG-TERM DEVIATIONS FROM MEAN DRIFTS= 1.99 N= 7.
MEAN SHORT-TERM DEVIATIONS (DEG.) FROM MEAN POSITIONS= ***** N= 17.
MEAN OF DEFINITE OR PROBABLE LIFETIMES= 103.2 DAYS N= 11.
MEAN PROPORTION= 2.0 N= 34.
MEAN LENGTH= 6.5 N= 34.
MEAN RATIO OF LENGTH-DEVIATION TO LENGTH= 0.22 N= 34.
MEAN SIGNED DEVIATION OF DRIFT FROM CURRENT MEAN (NEG=SLOW) -8.72 N= 40.
NUMBER OF DARK SPOTS= 24
NUMBER OF LIGHT SPOTS= 16

DISTRIBUTION OF SPOTS BY TYPE

TYPE	OVAL	SLANT	FESTOON	WAVE	ANGULAR	AMORPHOUS	VARIABLE	PREC. END	FOL. END
NUMBER	14		0	6	1	14	0	3	2

SPOTS ROTATING SIMILAR TO CURRENT MEAN

MEAN LONG-TERM DEVIATIONS FROM MEAN DRIFTS= 2.24 N= 15.
MEAN SHORT-TERM DEVIATIONS (DEG.) FROM MEAN POSITIONS= ***** N= 22.
MEAN OF DEFINITE OR PROBABLE LIFETIMES= 80.5 DAYS N= 10.
MEAN PROPORTION= 2.0 N= 41.
MEAN LENGTH= **** N= 41.
MEAN RATIO OF LENGTH-DEVIATION TO LENGTH= 0.23 N= 41.
MEAN SIGNED DEVIATION OF DRIFT FROM CURRENT MEAN (NEG=SLOW) -0.39 N= 46.
NUMBER OF DARK SPOTS= 25
NUMBER OF LIGHT SPOTS= 21

DISTRIBUTION OF SPOTS BY TYPE

TYPE	OVAL	SLANT	FESTOON	WAVE	ANGULAR	AMORPHOUS	VARIABLE	PREC. END	FOL. END
NUMBER	23		0	7	0	11	2	2	1

SPOTS ROTATING FASTER THAN CURRENT

MEAN LONG-TERM DEVIATIONS FROM MEAN DRIFTS= 1.77 N= 8.
MEAN SHORT-TERM DEVIATIONS (DEG.) FROM MEAN POSITIONS= ***** N= 20.
MEAN OF DEFINITE OR PROBABLE LIFETIMES= 170.9 DAYS N= 7.
MEAN PROPORTION= 2.2 N= 24.
MEAN LENGTH= 6.8 N= 24.
MEAN RATIO OF LENGTH-DEVIATION TO LENGTH= 0.21 N= 24.
MEAN SIGNED DEVIATION OF DRIFT FROM CURRENT MEAN (NEG=SLOW) 13.59 N= 27.
NUMBER OF DARK SPOTS= 18
NUMBER OF LIGHT SPOTS= 9

DISTRIBUTION OF SPOTS BY TYPE

TYPE	OVAL	SLANT	FESTOON	WAVE	ANGULAR	AMORPHOUS	VARIABLE	PREC. END	FOL. END
NUMBER	13		0	5	0	7	0	1	1

APPENDIX D

Lifetime-size Relationships

LIFETIME-LENGTH RELATIONSHIP

LENGTH WITHIN 2 DEGREES OF	2	6	10	14	18	22	26
LIFETIME 1 =	9.	17.	****	****	****	****	****
LIFETIME 2 =	****	40.	38.	****	46.	****	****
LIFETIME 3 =	298.	160.	232.	****	****	****	****
LIFETIME 4 =	****	****	****	****	****	****	****
LIFETIME 5 =	52.	104.	180.	208.	****	****	****
LIFETIME 6 =	24.	36.	29.	30.	71.	****	****

LIFETIME-AREA RELATIONSHIP

AREA WITHIN 5 SQ. DEG. OF	5	15	25	35	45	55	65
LIFETIME 1 =	13.	****	****	****	****	****	****
LIFETIME 2 =	34.	40.	39.	****	****	46.	****
LIFETIME 3 =	167.	190.	232.	****	****	****	****
LIFETIME 4 =	****	****	****	****	****	****	****
LIFETIME 5 =	198.	102.	122.	208.	****	****	****
LIFETIME 6 =	26.	35.	52.	49.	****	71.	****