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A DIVISION OF LOCKHEED AIRCRAFT CORPORATION

SEMI-ANNUAL TECHNICAL SUMMARY REPORT

19 February 1964

ARPA Order 215, Amend. No. 4

Contractor

LOCKHEED AIRCRAFT CORPORATION FOR
ITS DIVISION LOCKHEED-CALIFORNIA COMPANY

Burbank, California

Date of Contract - February 1, 1963

Amount of Contract - \$ 68,278.00

Contract Number - Nonr-3933(00)

Contract Expiration Date - January 31, 1965

Project Scientist - Dr. D. S. Webber

Phone No. Area Code 213

TRiangle 7-2711
Extension 61-257

Title of Work - RESEARCH ON SOLAR MAGNETIC FIELDS

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Signed:

D. S. Webber
D. S. Webber, Head
Solar Physics Laboratory

APR 1 1964
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This is the second semiannual technical summary report submitted under the provisions of Contract Nonr-3933(00), authorized by ARPA Order 215, Amendment No. 4, Project Code 2820, for Research on Solar Magnetic Fields. It covers the period 1 August 1963 through 31 January 1964.

During this six month period major strides were made in each of the three principle tasks of this research project. These tasks are:

- I. The survey and reduction of Mount Wilson magnetic field data.
- II. The analysis of the solar magnetic fields.
- III. The correlation of solar magnetic field configurations and changes with chromospheric phenomena.

Task I has been completed. Under this heading the following detailed work was accomplished:

- A. Reduction of Mount Wilson magnetograms into isogauss maps for the period August 1959 through December 1962.
- B. Identification and classification of all the magnetic field regions on the 703 isogauss maps.
- C. Tabulation of the following parameters for each of the 2080 regions on each day that the region was recorded:
 1. date, time of day, and quality of the isogauss map on which region appears
 2. longitude and latitude
 3. classification
 4. estimate of the area
- D. Calculation of the central meridian passage of each region to tenths of a day.

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E. Tabulation of the following summary data for each region for each passage across the sun's visible hemisphere:

1. region number
2. date of central meridian passage
3. average latitude
4. average quality of the maps and the total number of maps on which the region was visible
5. approximate area

Tasks II and III, the analysis of the solar magnetic regions and the correlation of these regions with chromospheric configurations and changes, are being carried out simultaneously. These two tasks which combined we simply refer to as "the analyses" have been separated into three areas of endeavor according to the analytical techniques being employed. Each of the three areas are briefly described below. Following each description is a summary of the achievements in that area as of 30 January 1964.

- A. Digital computer analysis - Computer programs will be constructed and run which will yield specific information from the large quantity of tabulated magnetic region data supplemented by comparable quantities of tabulated data on calcium plages, sunspots and flares.

The first step in this area is transferring the tabulated data to IBM punched-card format. Approximately half of the punching has been done. Construction of flow-charts and block diagrams preliminary to the writing of the programs has begun.

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- B. Chromosphere Study - A visual comparison of the isogauss maps and the chromosphere as recorded in H α on 35-mm film will be made employing a 35-mm projector.

Because of the enormous, non-measurable errors in the original magnetograms, this seemingly simple comparison will actually be one of the most difficult areas of study. Various methods were tested in order to find a convenient and efficient method of comparison which could yield reasonably objective results. A five step approach was selected. For details, see chart included with this report.

- C. Study of Unipolar Magnetic Fields - Unipolar regions as identified on the isogauss maps will be compared with the calcium plages on the Mt. Wilson images of the sun as seen in the K line of calcium.

A preliminary study was made to determine the course of the more complete investigation to follow. Results of this preliminary study indicate that:

1. Many unipolar regions are a product of old bi-polar regions.
2. There appears to be a tendency for unipolar regions to drift to higher latitudes as the regions age, perhaps an effect of the differential rotation of the sun.
3. There is no obvious correlation between large unipolar magnetic regions and the 27 day recurrent geomagnetic storms.

A more complete outline of the three areas of analysis described above is contained in the chart included with this report and with Quarterly Letter Report No. 4.

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An unexpected benefit may be realized from our search for information on unipolar magnetic regions. Because the Mt. Wilson calcium images are on glass plates, much care and time consuming labor was found to be necessary in the proper handling of these plates. To facilitate the study of information on these plates, it was decided that the images should be re-photographed on 35-mm film. This job was accomplished with an improvised set-up in the Lockheed Solar Physics Laboratory. To our knowledge this is the first time that a continuous solar film has been made on the basis of one image per day. This film, covering a period of over 3 years, offers amazing possibilities for new and more complete investigations of solar phenomena. Because this motion picture format permits rapid visual assimilation of information, more results than previously anticipated may be obtained before the expiration date of this contract.

MAGNETIC FIELD STUDY

Contract Number Monr 3933(00)

Input Data

Magnetograms - Mt. Wilson
 Calcium Spectroheliograms - Mt. Wilson
 H α Images - Lockheed
 Tabulated Ca Flare, Sunspot Data - Published by NBS in CRPL - B Series
 Tabulated Flare Data - NBS

1. Conversion of Magnetograms into Iso-gauss Maps
 Total 703

2. Computer Analysis

- 2.1 Identify regions & tabulate parameters: Area, Position, etc. (2028 regions)
- 2.2 Transfer data to punched cards
 - 2.2.1 Magnetic regions
 - 2.2.2 Calcium plages
 - 2.2.3 Sunspots
- 2.3 Purchase flare cards - NBS
- 2.4 Machine Program
 - 2.4.1 Construct flow charts
 - 2.4.2 Work with programmer
 - 2.4.3 Check output
- 2.5 Write results

3. Chromosphere Study

- 3.1 Test methods for direct comparison of iso-gauss maps Ca & H α spectroheliograms
- 3.2 Approach selected
 - 3.2.1 H α off-band drawings of plage structure
 - 3.2.2 Match H α off-band drawings with iso-gauss maps
 - 3.2.3 Draw flare maps reduced to iso-gauss map time
 - 3.2.4 Measure parameters for flakes, filaments, etc.
 - 3.2.5 Analyze
- 3.3 Write results

4. Unipolar Magnetic Fields

- 4.1 Preliminary study
- 4.2 Extended study
 - 4.2.1 Reproduce Ca & H α plates on 35-mm film
 - 4.2.2 Identify unipolar regions on Ca images
 - 4.2.3 Record
 - History
 - Intensity
 - Position
 - Other Characteristics
 - 4.2.4 Analyze
 - 4.2.5 Compare with occurrence of geomagnetic storms
- 4.3 Write results

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