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13. ABSTRACT Progress for the year included uncompleted analysis of 1966 eclipse plates for evidence of a difference in the chemical content of coronal condensations from that in the corona in general, continued work toward interpretation of the gradient of the emission-line features in the corona, the discovery of a linear relationship between flare productivity and length of the neutral lines in the longitudinal magnetic field in active regions, and the formulation of plans to study the color of the K-corona at the March 7, 1970, eclipse.			

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## PHYSICS OF THE SOLAR CORONA

We can break our efforts during the report period into four subdivisions: (1) Continuation of work by Mr. William Hatt on the question of chemical abundances in the corona; (2) Continuation by Billings, assisted by Jo Ann Baldwin, on efforts to interpret the emission gradients in the corona; (3) Completion by M. Peralta and Billings of a study on flare productivity, begun under Nonr 1147(13); and (4) Initial plans for an eclipse observation on March 7, 1970. Progress on each of these problems is as follows:

(1) Since Mr. Hatt has decided to take a teaching position at New England College, Henniker, New Hampshire, instead of completing a thesis, we decided to limit his problem to looking for the answer to a single question: Is the abundance of iron in a very strong coronal condensation that appears on the Dunn 1966 eclipse plates different from that outside the condensation? This is a very interesting question, since the theory of thermal diffusion would predict that the heavy, highly ionized atoms would migrate into hot, dense regions. To this end, he traced all of the plates and all of the large number of calibration shots. These tracings were made on the HAO microphotometer, and the output was digitized and recorded on magnetic tape. Mr. Hatt has spent most of the summer carrying out computer processes for getting this material into a meaningful form. When this is accomplished, we will have the advantage of having punched-card intensity profiles, point by point for all the lines, with higher precision than is possible from a chart recorder. During the past few weeks, he has been assisted by Miss Jo Ann Baldwin who can carry on the computer program. He plans to do additional paper work while in New Hampshire, and hopes to finish the project next summer.

(2) In the paper by Billings and Joselyn, "Physical Properties of  $\lambda$  5303 Coronal Emission Regions," Ap. J. 156, 739, 1969, we derived a form of the

equation of hydrostatic equilibrium applicable to the emission gradient in the corona. In that paper we used particular solutions to this equation. In an attempt to apply the theory to additional data accumulated by J. Park, however, we found it necessary to look to the general solutions of the equation. I have been looking into the structure of these general solutions, and believe that I now see a way of choosing appropriate solutions to be consistent with live-profile data.

(3) A "letter" by Peralta and Billings, which has been accepted for publication by the Journal of Geophysical Research, is attached to this report. It summarizes a remarkably simple device which we have found for predicting the flare-productivity of an active region.

(4) Early in the year we considered plans for studying the profile of the "Grotrian Depression" at the March 7, 1970 eclipse. This is the reported weakening in the coronal continuum due to the smearing out of the H and K lines. If its profile could be accurately determined, it should give a value for coronal temperature which would be independent of motion or atomic parameters. As funds did not appear to be available for such an observation, a more modest observation was outlined which would study the color of the two polarized components of the white-light corona. This proposal was accepted by NASA, and the NASA contract which was granted about July 1 will meet subsequent expenses of the eclipse observation.

I have been taking advantage this summer of various opportunities available on this campus for learning more about the corona. These have been three in number -- a study program on solar magnetohydrodynamics which has continued throughout the summer, a two-week workshop on orbiting solar observatories, August 4-15, sponsored by NASA and attended by solar scientists from many places, and a three-day symposium on the chromospheric-coronal interface, August 25-27. As a result of the OSO workshop, I have arrived at a concept of impulsive coronal heating which

I believe may explain a great many emission-line phenomena that have puzzled me through the years. I plan to follow this idea rather intensively during the remainder of 1969, spend the first three months of 1970 preparing for and attending the eclipse, then the remainder of the year in whatever study of the solar corona seems most promising.

Attachments: #

- 1) Pre-print: "Length of Neutral Lines as an Indicator of Flare Productivity." by Peralta and Billings, accepted for publication as a letter in the Journal of Geophysical Research.
- 2) Reprint: "Note on Solar Variability and Climatic Change," by Billings, Meteorological Monographs 8, 144-5, 1968.
- 3) Reprint: "A Coronal Enhancement in the Extreme Ultra-Violet," Boardman and Billings, Ap. J. 156, 731, 1969.
- 4) Reprint: "Physical Properties of  $\lambda$  5303 Coronal Emission Region," Billings and Joselyn, Ap. J. 156, 739, 1969.