Solar Absorption Lines between 2950 and 2200 Angstroms

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SOLAR spectrograms were taken by the Naval Research Laboratory on the V-2 rocket flights of October 10, 1946[1] and March 7, 1947. The spectra obtained at 55 km and 75 km on the respective dates have been studied to identify the Fraunhofer absorption lines in the region between 3000 and 2200A. Some 300 observable absorption features were compared to a master finding list of 1100 of the principal classified lines of the arc and spark spectra of elements 1 to 30. The heavier elements will be added as time permits. The finding list was prepared in collaboration with Dr. Charlotte Moore-Sitterly, who generously made available the unpublished multiplet lists which are being compiled as an extension of the Revised Multiplet Table[2] to cover the rocket ultraviolet region. Entries included laboratory intensities, assigned multiplet numbers, and, in many cases, her solar intensity predictions.

At the available resolution of about 1A, nearly every observed line is a blend; as many as 10 possible contributors to a single line have been found. Likely contributors have been assigned to nearly every observed feature, and work is under way to estimate their relative importance.

As in the previously known region, Fe *I* and Fe *II* are dominant and clearly contribute to a majority of the lines. In Fig. 1, the matching of many of the solar lines (indicated by dots) to the Fe arc spectrum is apparent. In the regions just below 2750, 2630, 2550, and 2490A there is a piling up of intense iron lines. This causes the whole level of the solar radiation to fall off sharply as shown in Fig. 1. In addition, many strong single Fe lines are found throughout the spectrum.

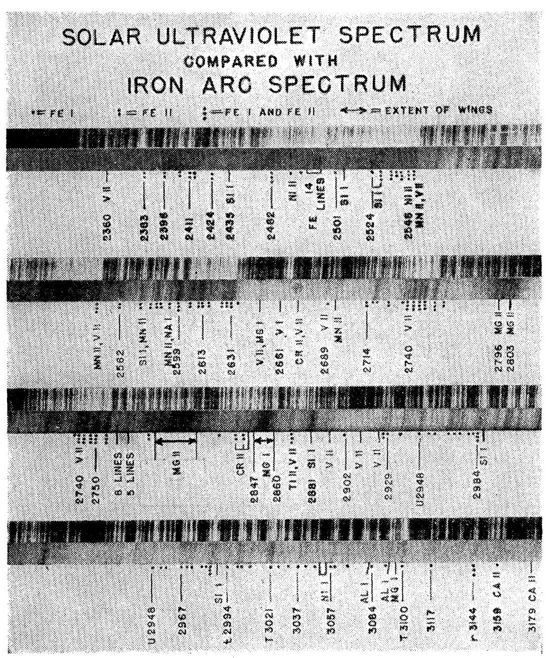

FIG. 1.

The great Mg *II* lines at 2803 and 2796A are of particular interest. They appear as two bright emission lines in the center of a great absorption band running from 2775 to 2825A.

Dr. Menzel of the Harvard Observatory offered the above explanation of the observed spectra and suggested the following explanation: A strong eruption of hydrogen occurred about 1 hour before the rocket flight, and the Mg emission may have originated in the prominence. However, similar emission lines, unresolved, may be inferred from the October 10 spectra, at which time no important prominences are known to have occurred.

Twelve lines of Si *I* of great intensity were found. The one at 2882 and the group between 2507 and 2529A showed strong wings. The existence of wings on the group between 2208 and 2219A could not be proved. A strong line of C *I* was found at 2478A.

In addition to the above elements one or more lines have been assigned as follows: definite, V *I*, V *II*, Cr *II*, Mn *II*, Co *I*, and Al *II*; probable, Na *I*, Ni *I*, Ni *II*, Cr *I*, Co *II*, Be *I*, and Al *I*; possible, P *I*, and Cu *I*. More definite assignments will be made taking into account multiplet intensity and the relative abundances of the elements.

There appear to be regions of general absorption between 2886 and 2893A and between 2442 and 2472A. The finding list contains few lines in these regions; the absorption may, therefore, be molecular.

A complete report of the analysis will be published later.

[1] W. A. Baum, F. S. Johnson, J. J. Oberly, C. C. Rockwood, C. V. Strain, and R. Tousey, Phys. Rev. **70**, 781 (1946).
[2] Charlotte E. Moore, "A revised multiplet table of astrophysical interest," Princeton Observatory.

Lower Bounds for Eigenvalues

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BARTA[1] has given a method for finding lower bounds for the "ground state" eigenvalue of a vibrating membrane. He does not claim that his method is as nice as the Rayleigh-Ritz method for finding upper bounds, but in a numerical example he shows that fair accuracy is obtainable.

The purpose of this note is threefold: (1) We extend Barta's method to include the Schrödinger equation, (2) the boundary conditions of Barta are relaxed, for instead of $u=0$ on the boundary we have $u\geq 0$, and this may be easier to apply in practice, (3) we give a very simple, but mathematically rigorous, proof. Barta makes use of the fact that the ground state eigenfunction is positive; the proof of this fact is very long and sophisticated.

Consider a continuous real function, ψ, which vanishes on the secondary of a region, R, and satisfies the n-dimen-

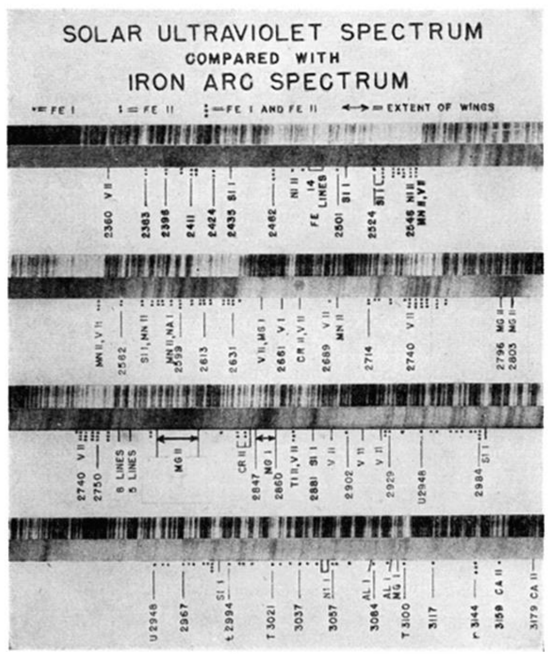
SOLAR ULTRAVIOLET SPECTRUM
COMPARED WITH
IRON ARC SPECTRUM
= FE I
= FE II
= FE I AND FE II
= EXTENT OF WINGS

FIG. 1.