

No. 161 ARIZONA-NASA ATLAS OF INFRARED SOLAR SPECTRUM, REPORT V

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ABSTRACT

In this report Charts 23-32 of the *Atlas* are given, containing the solar spectrum $\lambda\lambda 12187-17731 \text{ \AA}$, obtained from the NASA CV-990 Jet at an altitude of 39,000 ft with the LPL 4-meter spectrometer. A 600-lines/mm grating was used, blazed at 1.6μ . The Michigan Atlas spectra and an LPL laboratory spectrum of the $2 \nu_3$ (1.6μ) CH_4 band are included for comparison.

The Arizona-NASA Atlas will be divided into 4 parts:

Part I: Solar spectra, obtained with the 4-m spectrometer and a 1200-lines/mm grating. In preliminary form, Part I is published in *Comm. LPL* Nos. 123, 124, and 160; it extends from $\lambda\lambda 8487-14707$, with two gaps, occasioned by the pressure of observing time, $\lambda\lambda 9725-10657$ and $\lambda\lambda 12857-13138 \text{ \AA}$; neither one contains heavy telluric absorptions.

Part II: Solar spectra, obtained with the 4-m spectrometer and a 600-lines/mm grating, *Comm. LPL* Nos. 161, 163, 164, and 166, together covering the interval $\lambda\lambda 12187-30900 \text{ \AA}$, with some duplication and no gaps.

Part III: Solar spectra, obtained with the 4-m spectrometer and a 300-lines/mm grating. A preliminary report is given in *Comm. LPL* No. 125, for the region $3.1-3.3 \mu$; supplementary spectra to about 6μ are to be obtained with the NASA-Ames Lear Jet and a new open-port spectrometer now nearly ready for test flights.

Part IV: Solar spectra, obtained with the LPL B-spectrometer and different gratings. First reports on this part of the Atlas will be given in *Comm. LPL* Nos. 162 and 165. The resolutions in Part IV are lower than those in the other Parts, by factors of 2-4, the same gratings having been used but the focal length of the B-spectrometer camera being only 0.95 m.

Supplementary ground-based solar and laboratory spectra will be added as needed.

This report gives the Charts 23–32 ($\lambda\lambda 12187$ – 17731), the first 10 charts of Part II of the Atlas. Relevant data on these are listed in Table 1. The interval $\lambda\lambda 12187$ – 14707 is reproduced on Charts 23–27 (Figs. 1–4) and overlaps Part I of the Atlas; it covers the gap that occurs on Chart 15 between strips *b* and *c*. The division of work among the authors is the same as in *Comm.* 160.

As before, corresponding parts of the Michigan *Photometric Atlas of the Near Infrared Solar Spectrum* $\lambda 8465 - \lambda 25242$ are included for comparison.

The resolving power may be estimated from the pairs of lines at $\lambda\lambda 15729$, 16022 , and 16157 \AA , which are just clearly separated. The lines in each pair are, according to Mohler's *Table*, 0.3 cm^{-1} or about 0.8 \AA apart. The resolving power therefore is 0.3 cm^{-1} , almost identical to the resolving power of the Michigan *Atlas*, as may be verified by comparing pairs of solar lines in both sets of records.

A laboratory spectrum of the $2 \nu_3$ methane band at 1.6μ is included in Fig. A. A 10-cm absorption cell with $p = 9 \text{ cm}$ methane was placed in the light-beam, thus corresponding to an amount of methane of 12 mm atm . The spectrum was used in estimating the relative intensities of the methane lines in the solar spectrum.

As before, available identifications of the stronger solar lines are included in the solar records. All observed absorption lines are marked with a numbered dot below the spectral trace; above this trace, a dot indicates absorption by H_2O , a vertical line by CO_2 , and a triangle by CH_4 .

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REFERENCES

- Mohler, O. C., Pierce, A. K., McMath, R. R., and Goldberg, L. 1950, *Photometric Atlas of the Near Infrared Solar Spectrum* $\lambda 8465$ to $\lambda 25242$, Ann Arbor.
- Mohler, O. C. 1955, *A Table of Solar Spectrum Wavelengths 11904 \text{ \AA} to 25570 \text{ \AA}, Ann Arbor.*

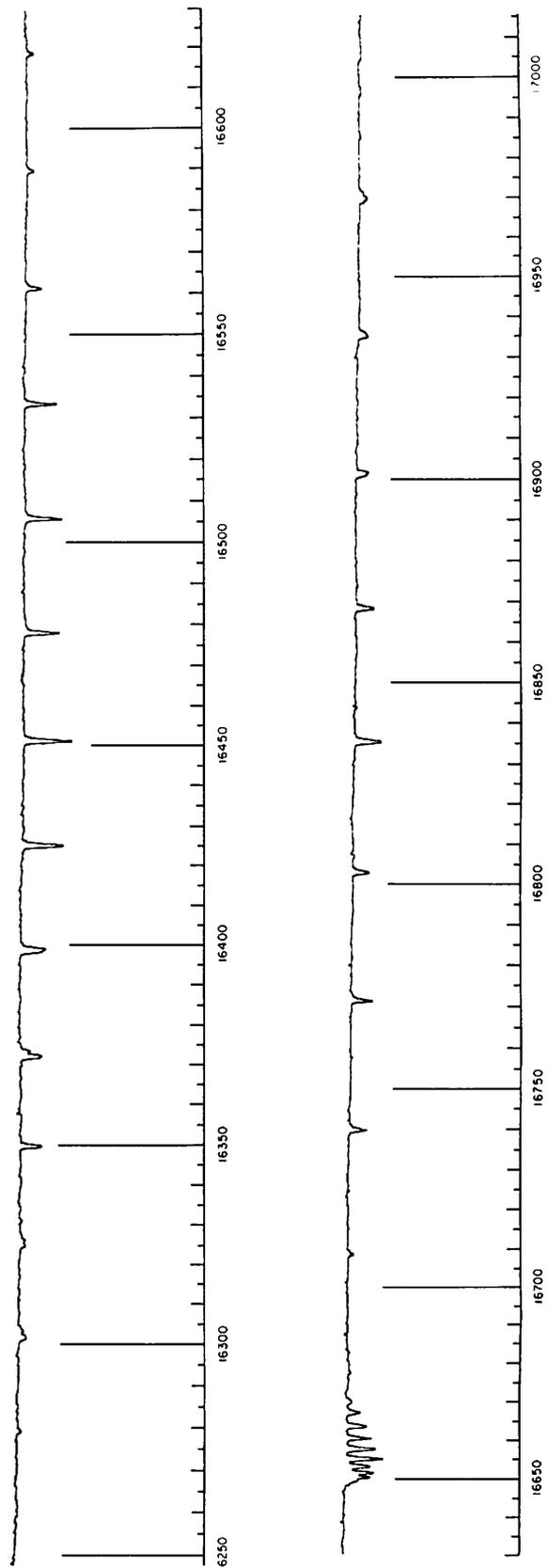


Fig. A Laboratory spectrum of $2 \nu_3$ methane band. (Scale different from solar spectrum scale.)

TABLE 1
 SOLAR SPECTRUM RECORDS, 4-M SPECTROMETER, NASA CV-990 JET
 1.6 μ GRATING (600 LINES/MM), SLIT AND CELL 0.10 MM, PbS CELL (-70°C), τ = 0.12 SEC, 1 μ FILTER

| FIG. | CHART | λ(Å) | 1968 DATE | UT | ALT. (FT) | OUTSIDE TEMP. (°C) | CABIN ALT. (FT) | GAIN |
|------|-------|--------------|-----------|--------------|-----------|--------------------|-----------------|------|
| 1. | 23 a | 12187-12239 | July 17 | 18:15; 18:20 | 39,000 | -49°C | 8500 | 4-6 |
| | b | 12239-12414 | July 17 | 18:17 | 39,000 | -49 | 8500 | 4-6 |
| | c | 12239-12414 | July 17 | 18:22 | 39,000 | -49 | 8500 | 4-6 |
| | d | 12414-12584 | July 17 | 18:25 | 39,000 | -49 | 8500 | 4-6 |
| 2. | 24 a | 12584-12762 | July 17 | 18:28 | 39,000 | -49 | 8500 | 4-6 |
| | b | 12762-12943 | July 17 | 18:32 | 39,000 | -49 | 8500 | 4-6 |
| | c | 12943-13120 | July 17 | 18:35 | 39,000 | -49 | 8500 | 4-6 |
| | d | 13120-13299 | July 17 | 18:39 | 39,000 | -49 | 8500 | 4-6 |
| 3. | 25 a | 13299-13476 | July 17 | 18:42 | 39,000 | -49 | 8500 | 4-6 |
| | b | 13476-13654 | July 17 | 18:45 | 39,000 | -49 | 8500 | 4-6 |
| | c | 13654-13829 | July 17 | 18:48 | 39,000 | -49 | 8500 | 4-6 |
| | d | 13829-14006 | July 17 | 18:52 | 39,000 | -49 | 8500 | 4-6 |
| 4. | 26 a | 14006-14182 | July 17 | 18:55 | 39,000 | -50 | 8500 | 4-6 |
| | b | 14182-14357 | July 17 | 18:58 | 39,000 | -50 | 8500 | 4-6 |
| | c | 14357-14534 | July 17 | 19:02 | 39,000 | -50 | 8500 | 4-6 |
| | d | 14534-14708 | July 17 | 19:06 | 39,000 | -50 | 8500 | 4-6 |
| 5. | 27 a | 14708-14868 | July 17 | 19:09 | 39,000 | -50 | 8500 | 4-6 |
| | b | 14868-15032 | July 17 | 19:12 | 39,000 | -50 | 8500 | 4-6 |
| | c | 15032-15195 | July 17 | 19:16 | 39,000 | -50 | 8500 | 4-6 |
| | d | 15195-15355 | July 17 | 19:19 | 39,000 | -50 | 8500 | 4-6 |
| 6. | 28 a | 15355-15513 | July 17 | 19:22 | 39,000 | -50 | 8500 | 4-6 |
| | b | 15513-15672 | July 17 | 19:25 | 39,000 | -50 | 8500 | 4-6 |
| | c | 15672-15825 | July 17 | 19:27 | 39,000 | -50 | 8500 | 4-6 |
| | d | 15825-15885 | July 17 | 19:29 | 39,000 | -50 | 8500 | 4-6 |
| | | 15825-15885 | July 17 | 19:36 | 39,000 | -50 | 8500 | 4-6 |
| 7. | 29 a | 15885-16060 | July 17 | 19:31; 19:35 | 39,000 | -51 | 8500 | 4-6 |
| | b | 15885-16058 | July 17 | 19:39 | 39,000 | -51 | 8500 | 4-6 |
| | c | 16058-16230 | July 17 | 19:42 | 39,000 | -51 | 8500 | 4-6 |
| | d | 16230-16400 | July 17 | 19:46 | 39,000 | -51 | 8500 | 4-6 |
| 8. | 30 a | 16400-16571 | July 17 | 19:49 | 39,000 | -51 | 8500 | 4-6 |
| | b | 16571-16739 | July 17 | 19:53 | 39,000 | -51 | 8500 | 4-6 |
| | c | 16739-16852 | July 17 | 19:56 | 39,000 | -51 | 8500 | 4-6 |
| | d | 16739-16854 | July 17 | 19:58 | 39,000 | -51 | 8500 | 4-6 |
| 9. | 31 a | 16854-17010 | July 17 | 20:00 | 39,000 | -52 | 8500 | 4-6 |
| | b | 17010-17168 | July 17 | 20:03 | 39,000 | -52 | 8500 | 4-6 |
| | c | 17168-17318 | July 17 | 20:06 | 39,000 | -52 | 8500 | 4-6 |
| | d | 17318-17398 | July 17 | 20:08 | 39,000 | -52 | 8500 | 5-2 |
| | | *17325-17398 | July 19 | 20:21 | 39,000 | -53 | 8500 | 5-3 |
| 10. | 32 a | 17398-17564 | July 17 | 20:11 | 39,000 | -52 | 8500 | 5-2 |
| | b | *17398-17564 | July 19 | 20:24 | 39,000 | -53 | 8500 | 5-3 |
| | c | 17564-17731 | July 17 | 20:14 | 39,000 | -52 | 8500 | 5-2 |
| | d | *17564-17731 | July 19 | 20:27 | 39,000 | -53 | 8500 | 5-3 |

*Slit = 0.08 mm

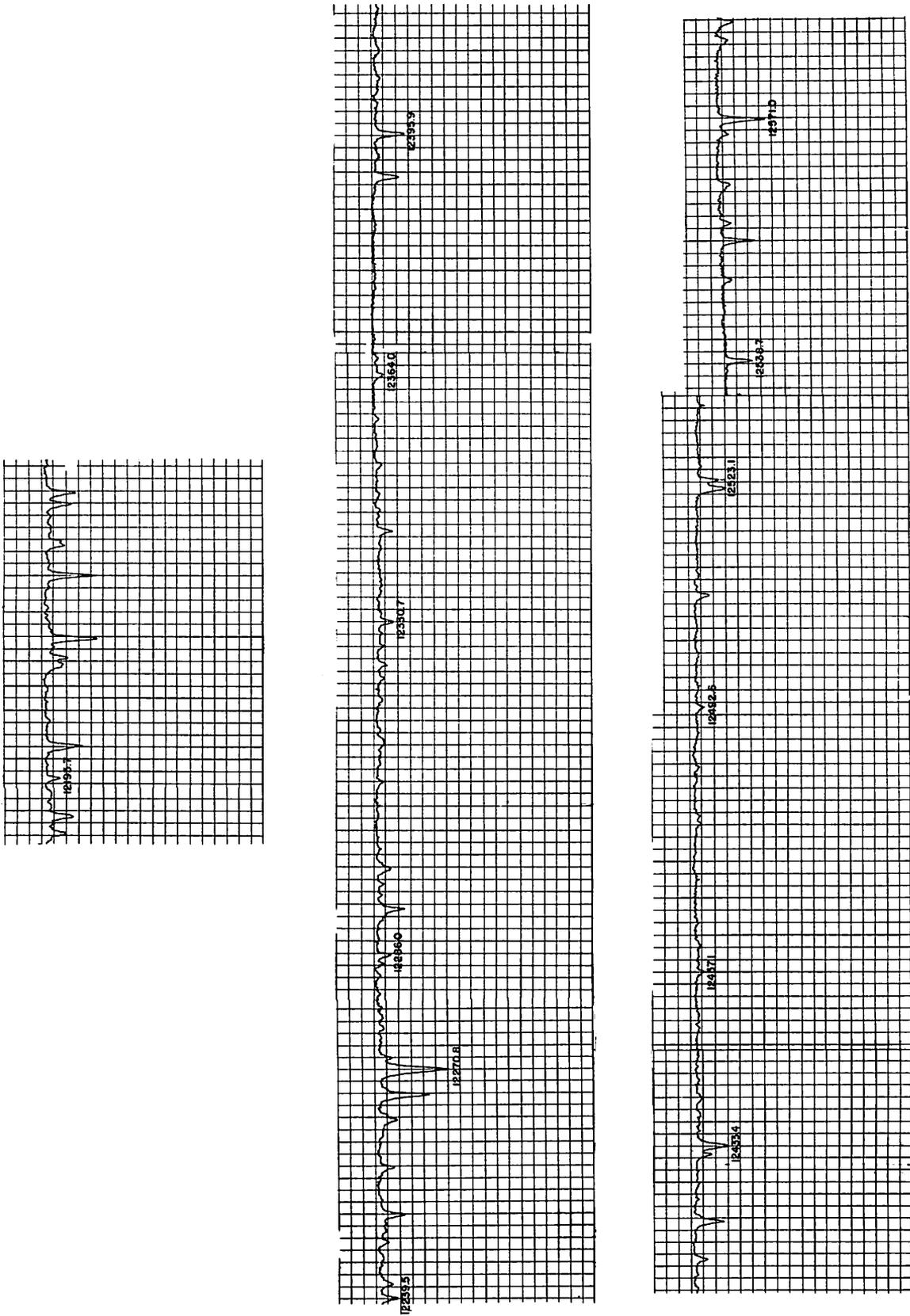


Fig. 1M Part of Michigan Atlas that matches Fig. 1 (1M-10M reproduced with permission.)

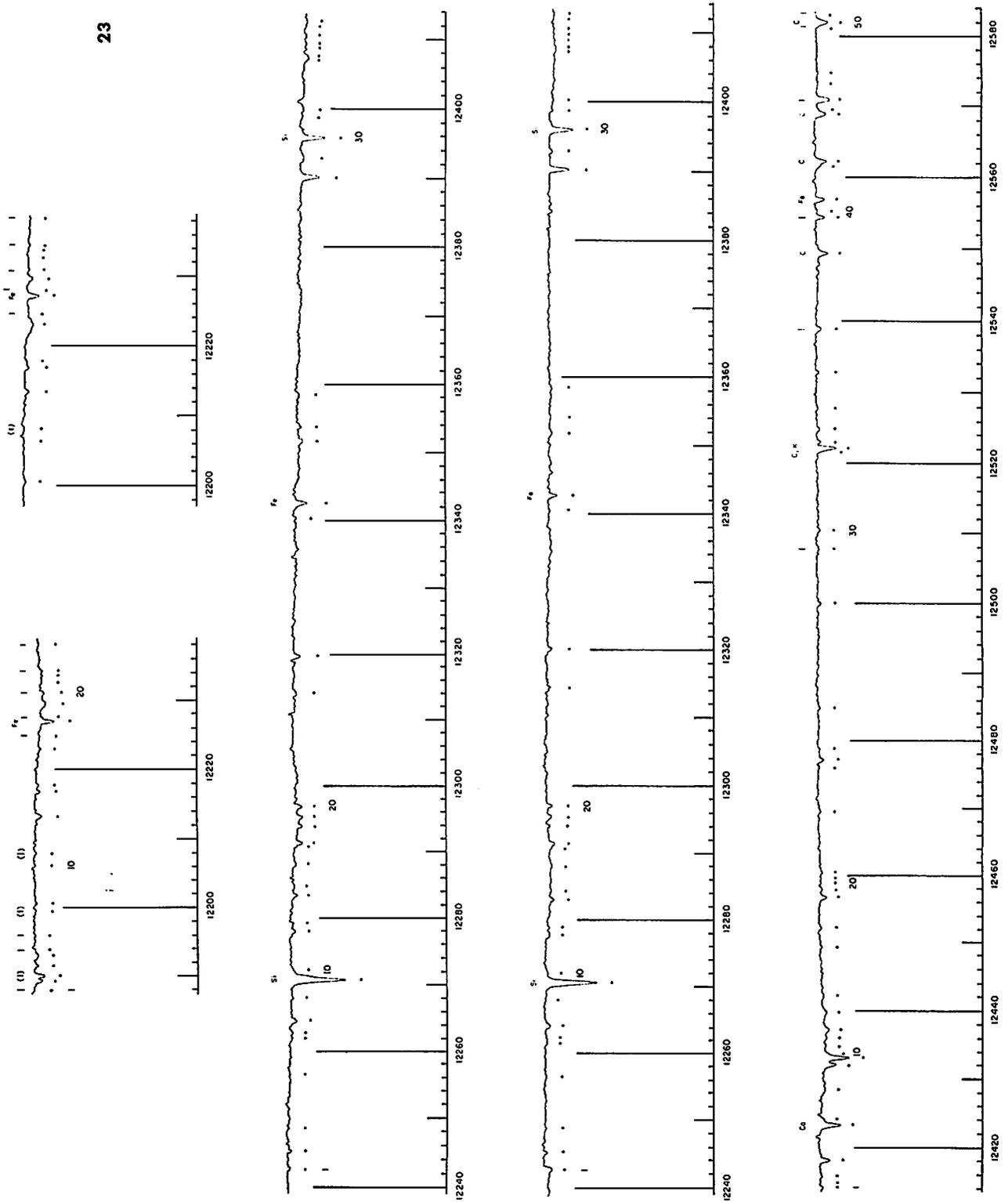


Fig. 1 Solar Spectrum $\lambda\lambda 12187-12584 \text{ \AA}$, in four strips (cf. Table 1).

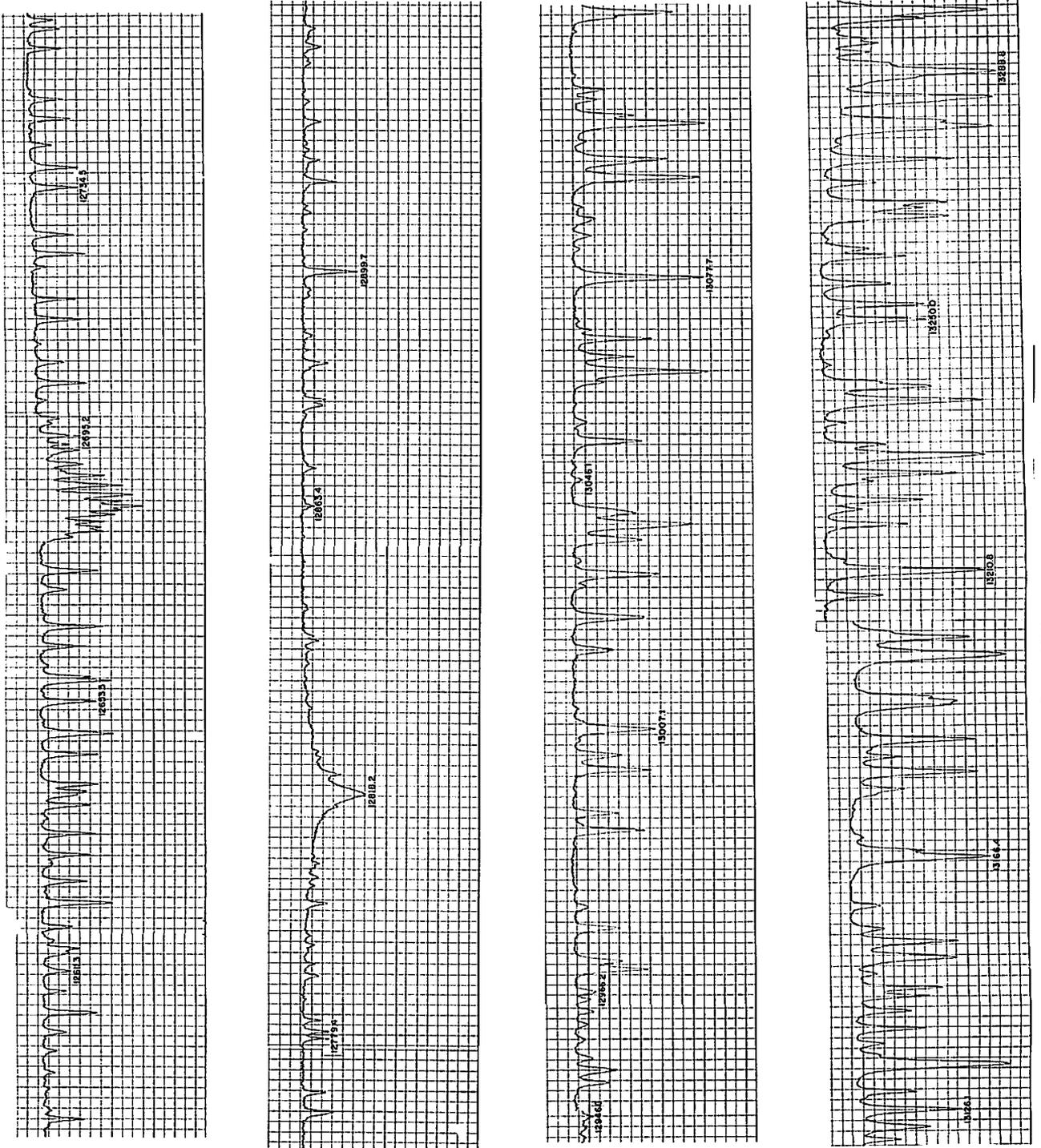


Fig. 2M Part of Michigan Atlas that matches Fig. 2.

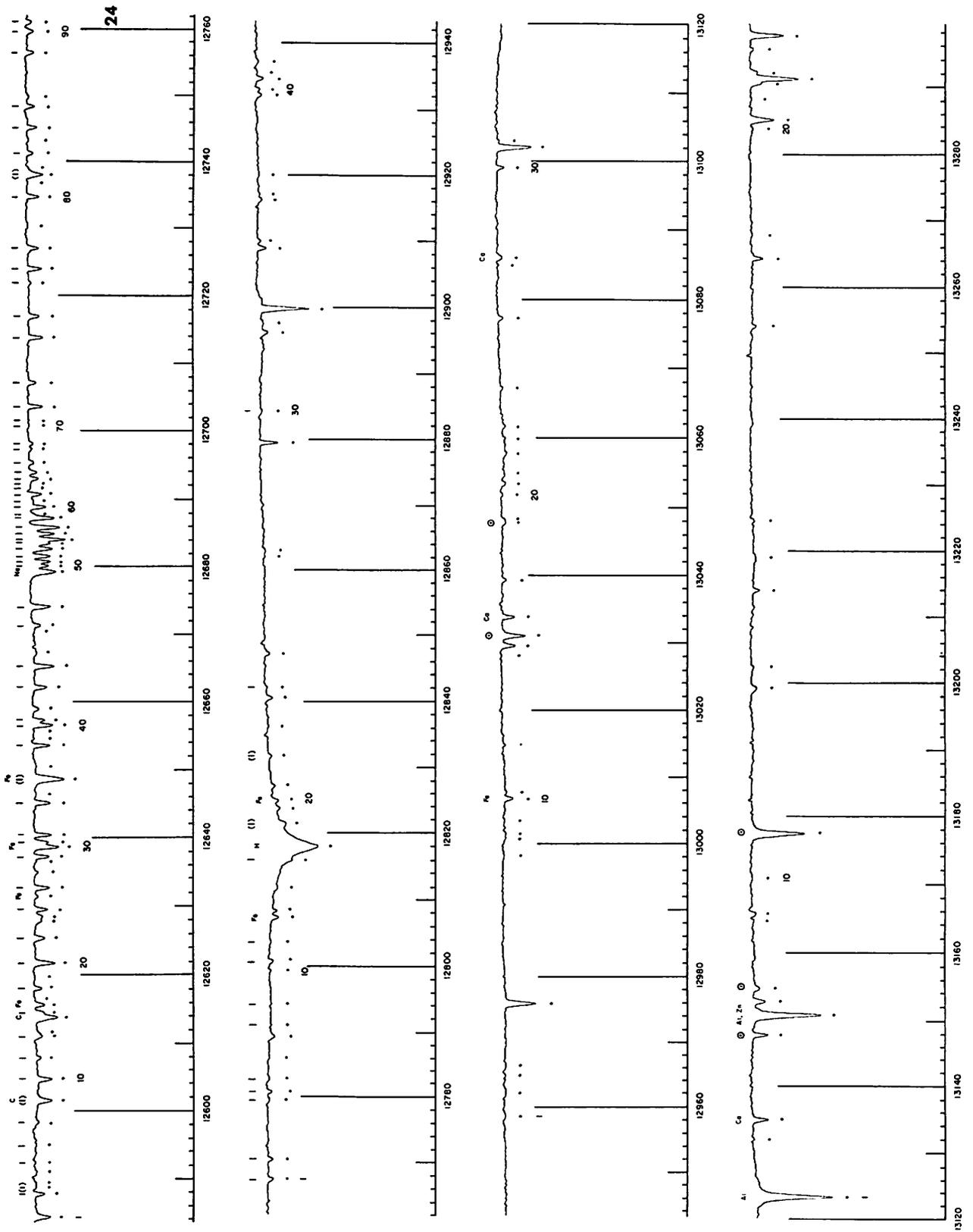


Fig. 2 Solar Spectrum $\lambda\lambda 12584-13299 \text{ \AA}$, in four strips (cf. Table 1).

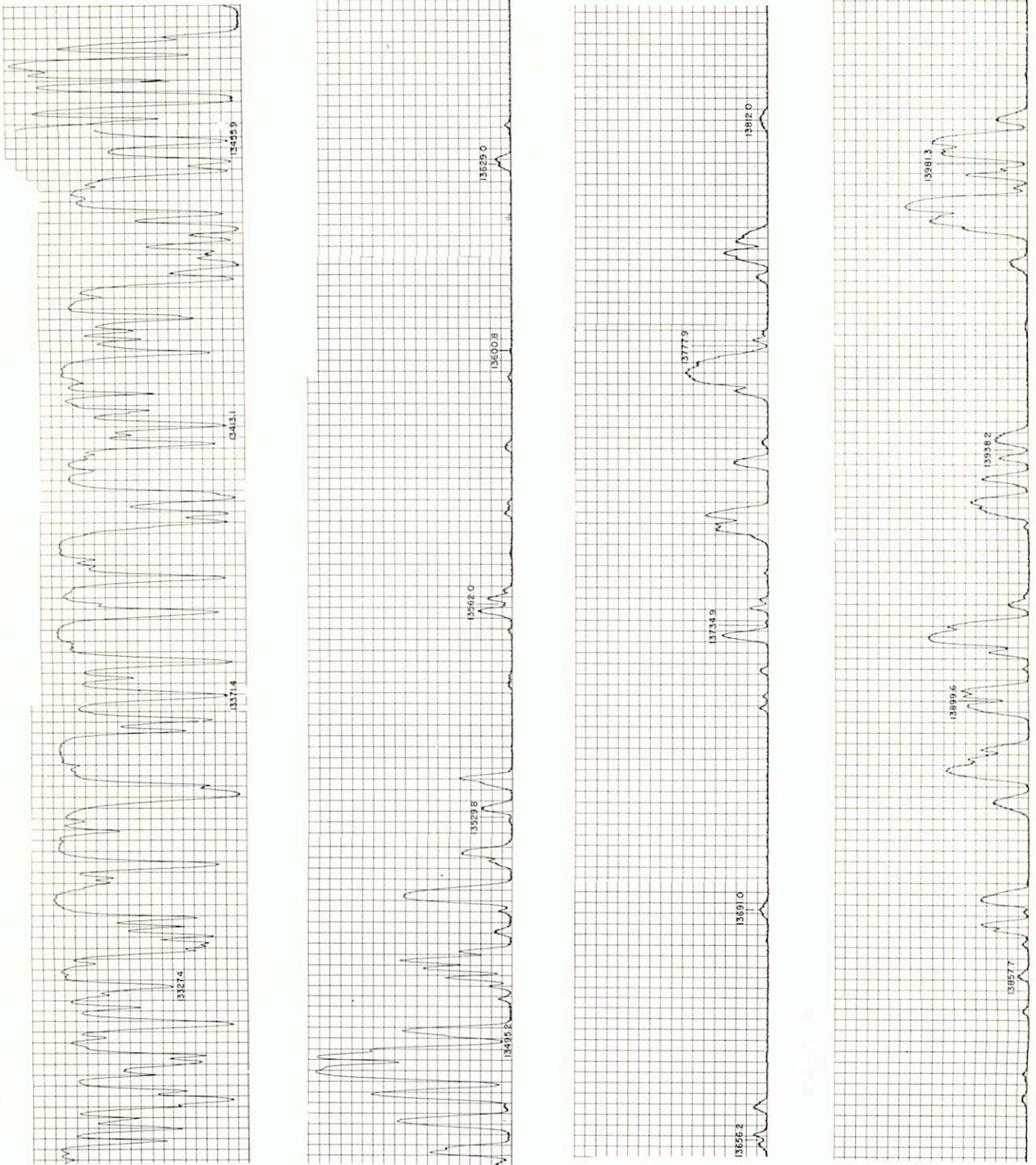


Fig. 3M Part of Michigan Atlas that matches Fig. 3.

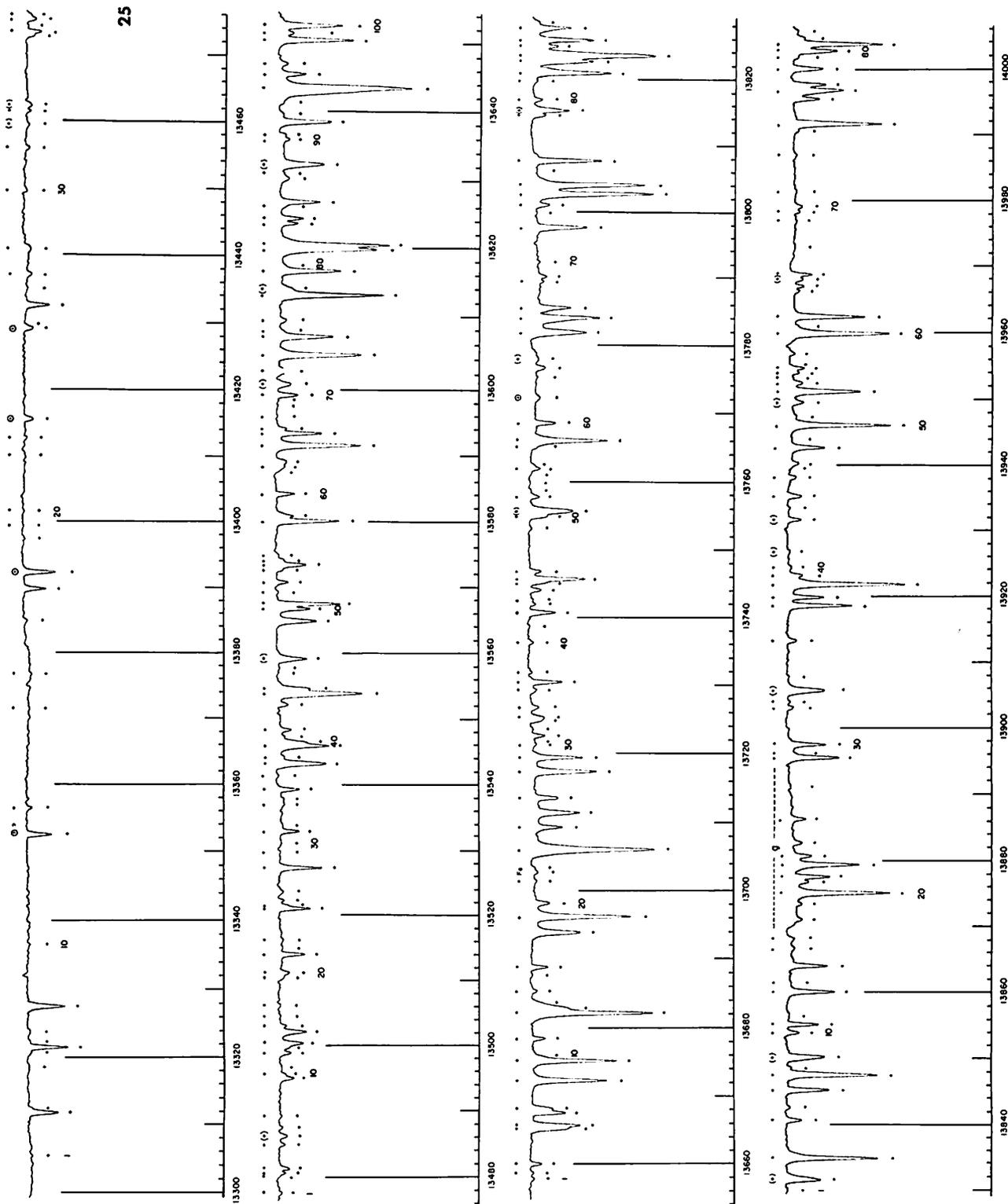


Fig. 3 Solar Spectrum $\lambda\lambda 13299-14006$ Å, in four strips (cf. Table 1).

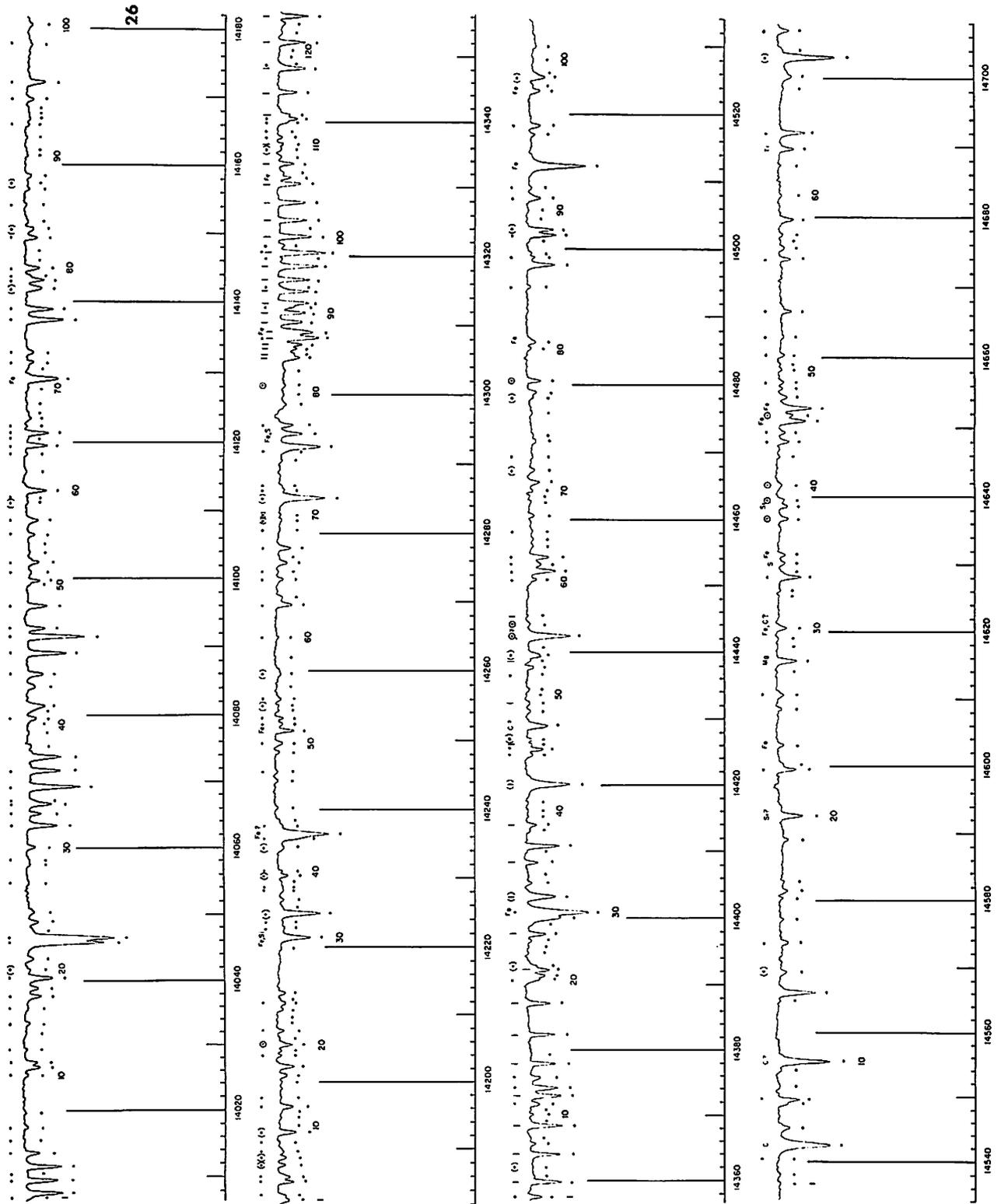


Fig. 4 Solar Spectrum $\lambda\lambda 14006-14708 \text{ \AA}$, in four strips (cf. Table I).

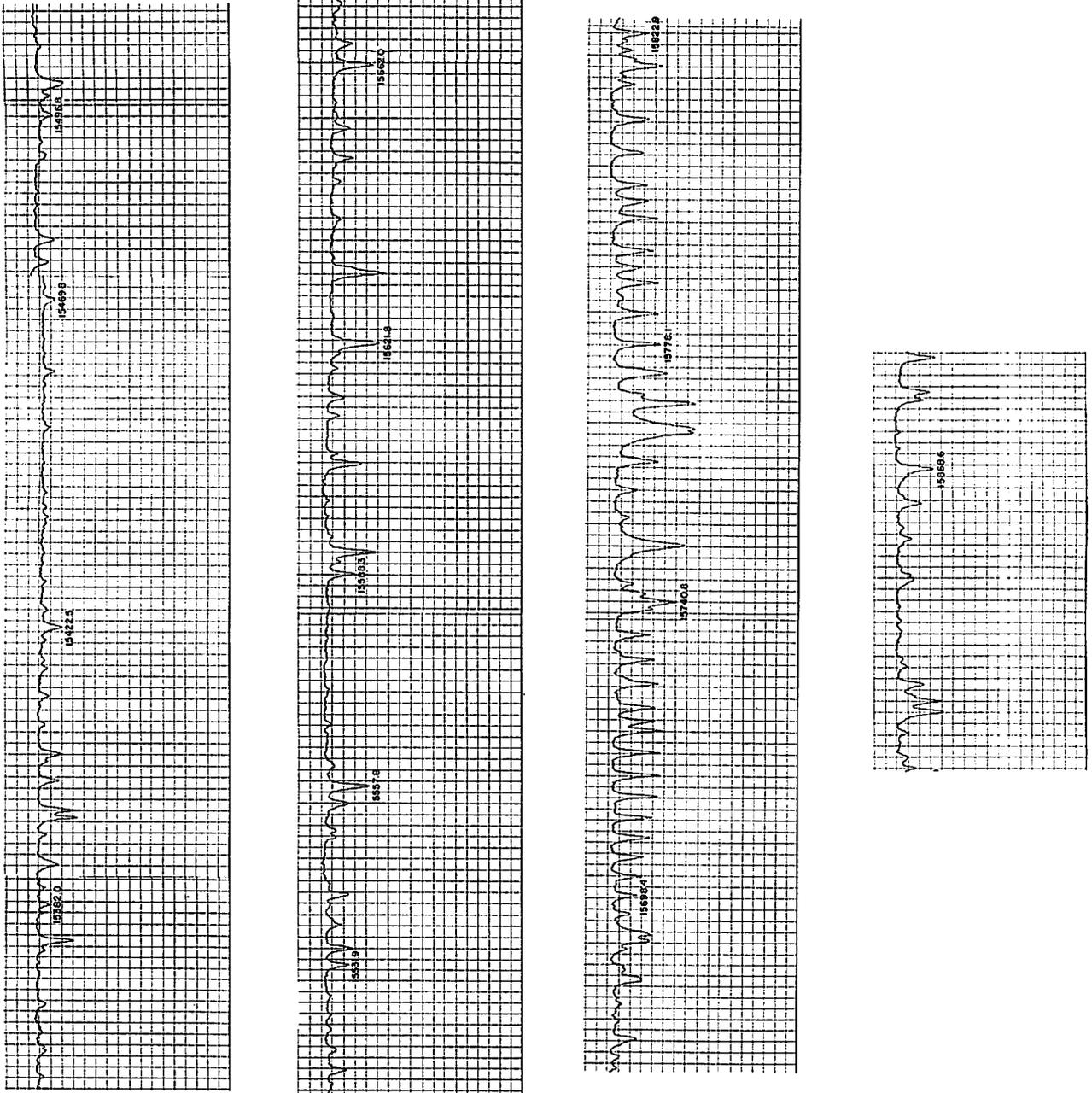


Fig. 6M Part of Michigan Atlas that matches Fig. 6.

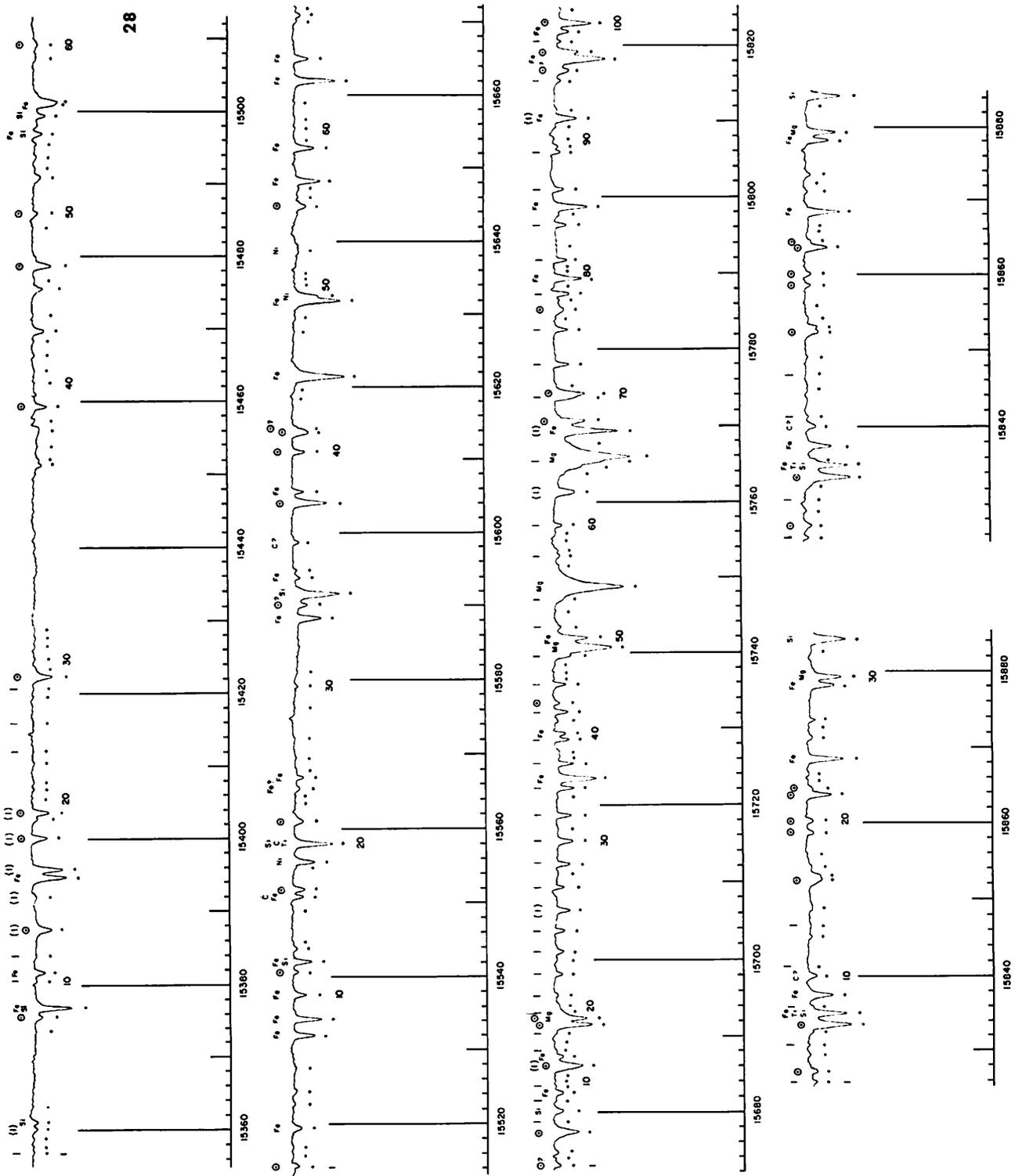


Fig. 6 Solar Spectrum $\lambda\lambda 15355-15885 \text{ \AA}$, in four strips (cf. Table 1).

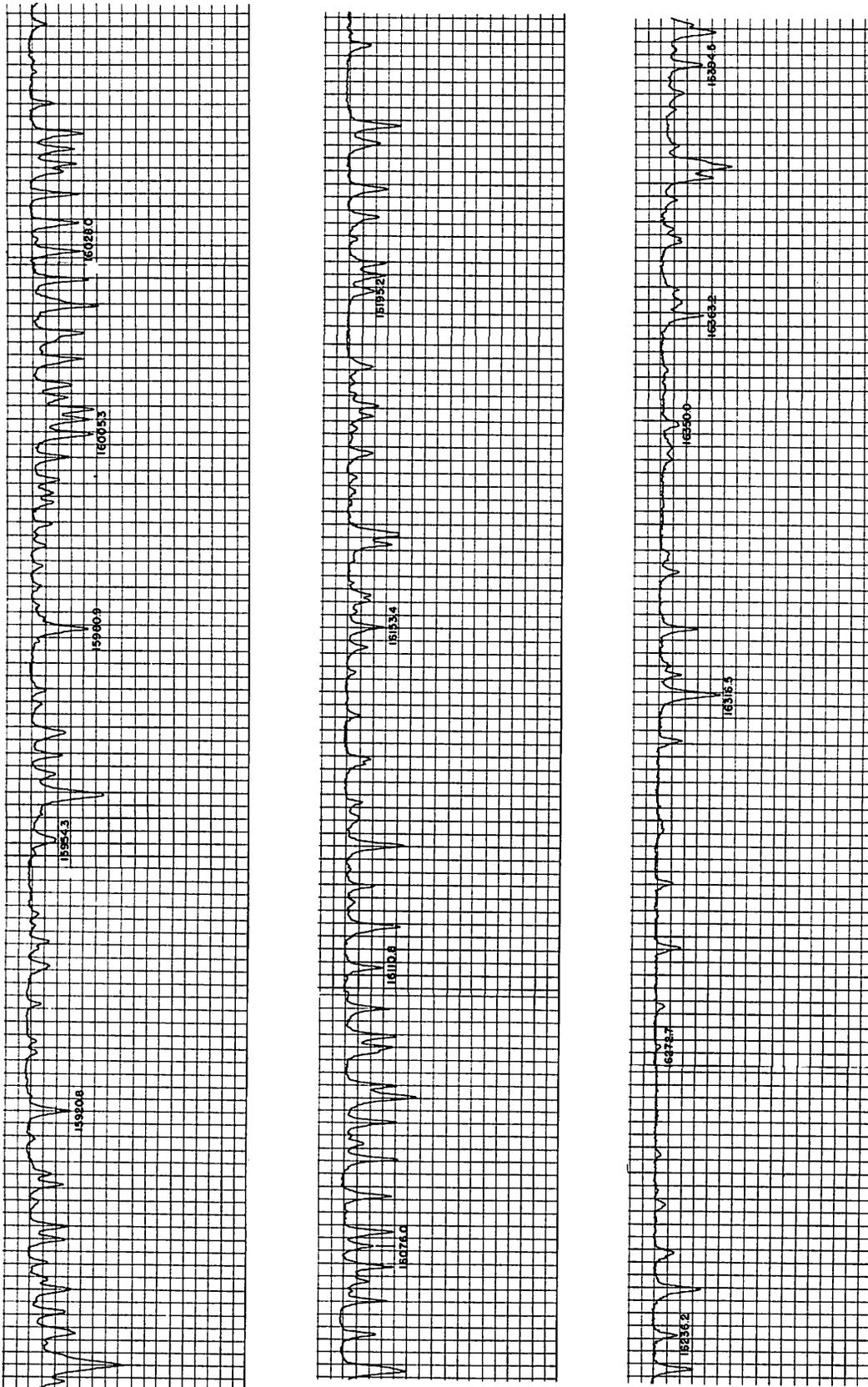


Fig. 7M Part of Michigan Atlas that matches Fig. 7.

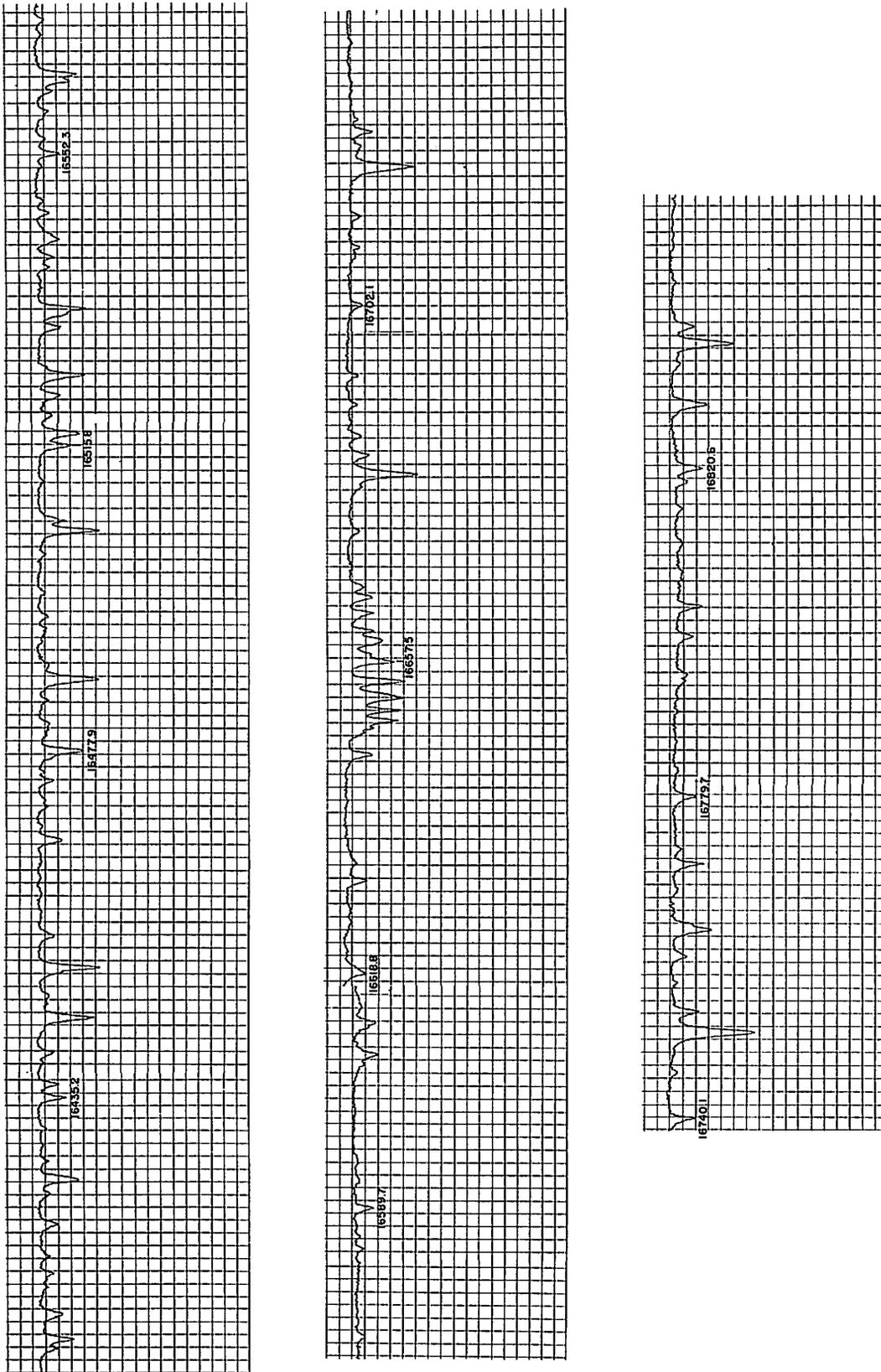


Fig. 8M Part of Michigan Atlas that matches Fig. 8.

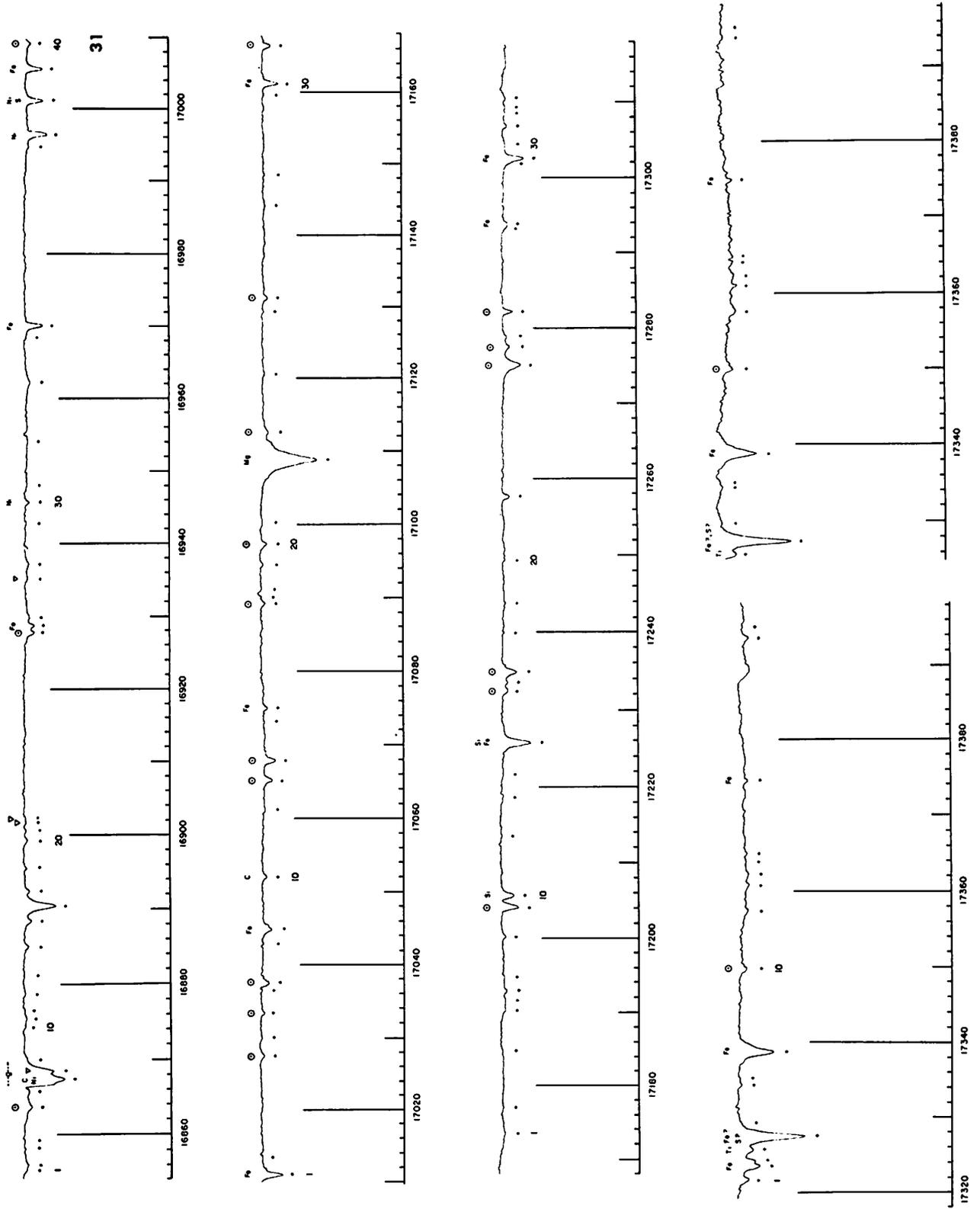


Fig. 9 Solar Spectrum $\lambda\lambda 16854-17398 \text{ \AA}$, in four strips (cf. Table 1).

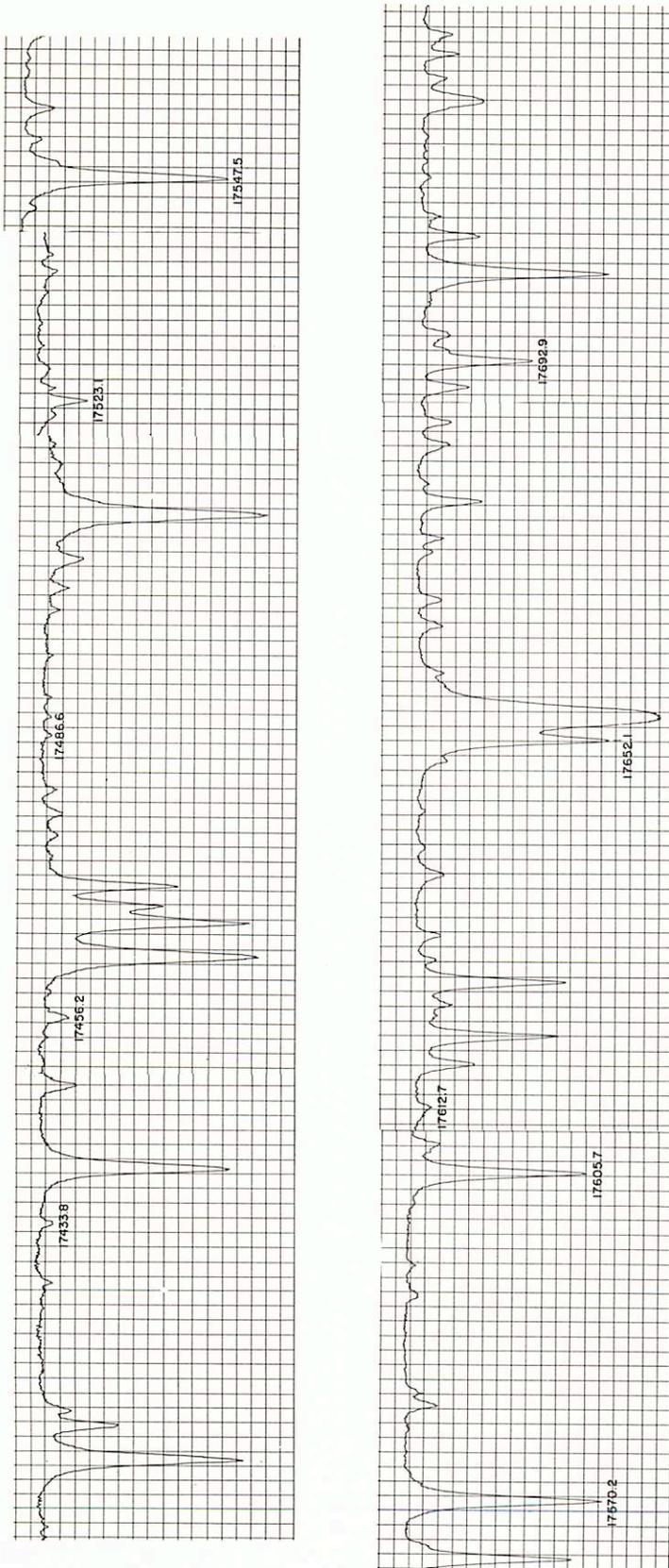


Fig. 10M Part of Michigan Atlas that matches Fig. 10.

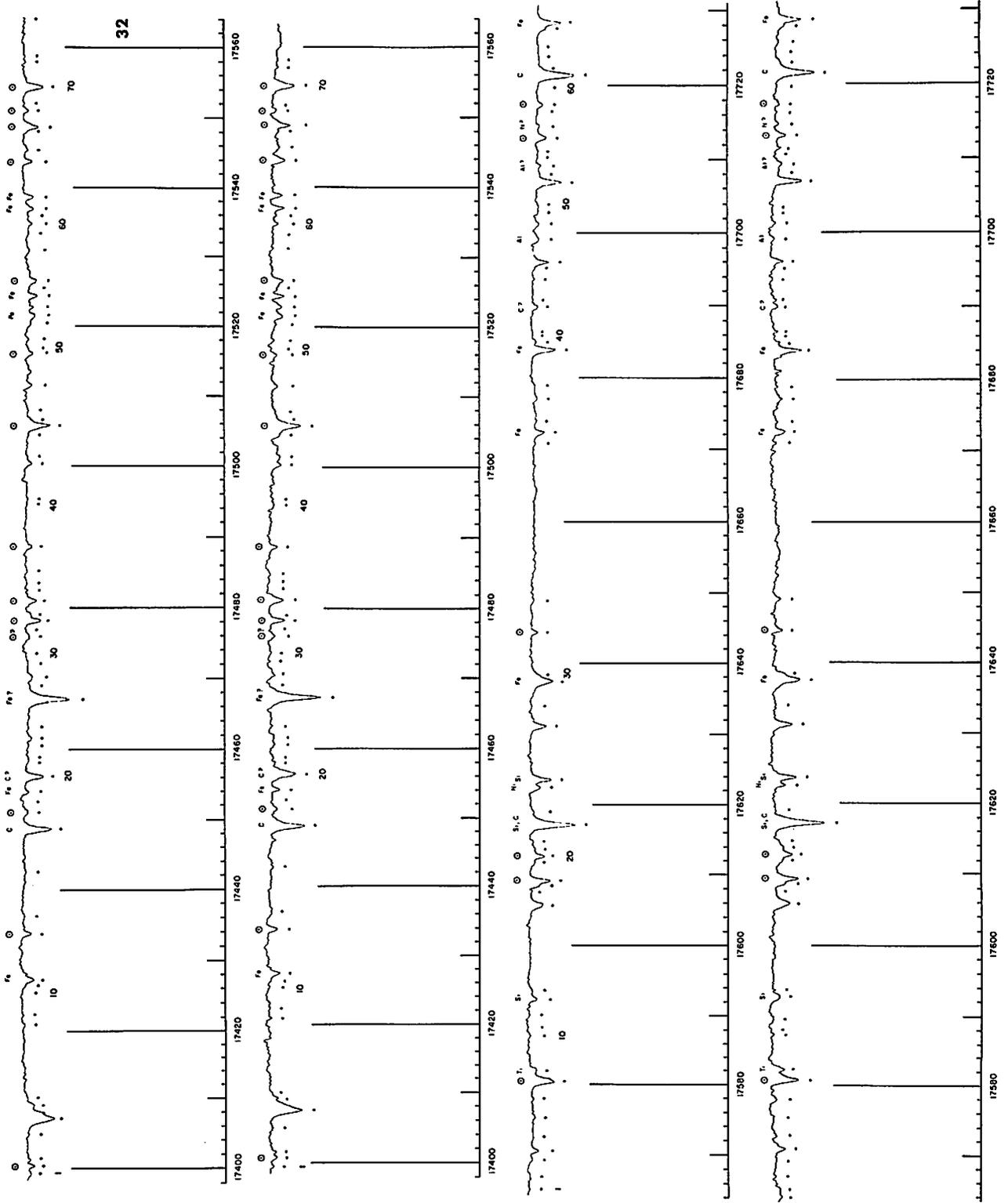


Fig. 10 Solar Spectrum $\lambda\lambda 17398-17731 \text{ \AA}$, in four strips (cf. Table I).