# ULTRA-VIOLET CONTENT OF SUNLIGHT AT BOMBAY.

By N. R. TAWDE, S. A. TRIVEDI AND J. M. PATEL.

Royal Institute of Science, Bombay.

**ABSTRACT.**—By using the methods of photographic photometry, the effective energy distribution of solar radiations at Bombay has been measured and the percentage ultra-violet content of it has been calculated. It is thus found that only about 2·43 % is ultra-violet light in solar radiations.

The uses of ultra-violet light for various purposes in medical science are not unknown. Mercury arc is by far the principal source which is in constant use for this purpose as it emits copious ultra-violet radiations. Of the natural sources, the sun plays a great part in giving out invisible ultra-violet radiations which have certain beneficial as well as harmful effects depending upon dosage. It is precisely for this purpose that it is desirable to know the ultra-violet energy content of sunlight under various conditions and its proportion to total energy received. The present problem was undertaken with a view to place on record some data which will prove useful in this direction.

The problem is set difficult owing to rapidly varying conditions of the atmosphere during different seasons and during different periods of the day. The length of the absorbing layer may also affect the results as it is likely to be different at different places. Consequently the investigations which are undertaken in this paper relate to a single place under some defined conditions set forth in the following paragraph :

It must be made clear that what are given in this paper are the results of effective radiations which are recorded after loss by all causes when passing through the absorbing layer of the atmosphere.

## EXPERIMENTAL.

The measurements were made in this laboratory during the month of September, 1935. The method adopted is that of spectral photometry. It has the advantage that it eliminates long exposures during which the conditions are likely to alter a great deal. An ideal hour and day on which the atmosphere appeared to be perfectly clear was chosen to photograph the solar spectrum. In order to know the proportion of ultra-violet radiations it is only necessary to obtain the relative energy at various wave-lengths along the whole spectrum. For this purpose, a standard comparison lamp calibrated by one of us, under known conditions, at the Government Chemical Laboratories, London, was used.

On account of short exposures needed, the time chosen to carry out these experiments was somewhere between 2 and 3 P. M. in the afternoon. A beam of sun-light after reflection from one face of a quartz prism was allowed to fall on the slit of the spectrograph which was a Fuess quartz instrument giving the whole range from about 7000 Å to 2000 Å. The procedure was to photograph the solar spectrum for a known interval of time and side by side to put calibration marks on the plate through a step-slit of six elements by means of the standard lamp. The exposure time which did not in any experiment exceed 3 minutes was adjusted to be the same for both the spectra as this is an essential condition in all quantitative measurements of this type. The blackening produced by the solar spectrum at any wave-length was somewhere between the strongest and the weakest of calibration marks. The plates were Ilford Rapid Process Panchromatic and those to be measured were developed under uniform conditions. Final plates to be placed under the self-recording microphotometer were chosen after several trials.

For purposes of taking the microphotometer records, points were chosen along the spectrum at intervals of not more than 50 A. U. and the spot of light was run across the spectrum and calibration marks at each of these points. This enabled the blackening intensity curve to be prepared for wave-lengths correspod-ing to each of these points and also to calculate the blackening produced by the solar spectrum at each wave-length. This latter blackening was then converted into intensity by means of the blackening-intensity curve. The actual intensity values at various wave-lengths from 5800 Å. to 3000 Å. were thus obtained and these were then exressed in terms of the energy of the standard lamp by multiply-ing them by $E_\lambda$ values derived from the $E_\lambda : \lambda$ curve. A correction for disper-sion was further applied by knowing the dispersion curve of the given spectro-graph. Final results were then expressed on a graph giving the relation $E_\lambda : \lambda$ of the solar spectrum. Some of the values from which the curve was prepared are given below :

RESULTS.

| Wave-length $\lambda$ | Energy $E_\lambda$ (solar spectrum) |
|---|---|
| 3200 | 11·66 |
| 3400 | 21.13 |
| 3600 | 22·09 |
| 3800 | 24·83 |
| 4000 | 46·17 |
| 4200 | 73·92 |
| 4400 | 104·32 |
| 4600 | 139·21 |
| 4800 | 178·50 |
| 5000 | 226·22 |
| 5200 | 272·15 |
| 5400 | 319·80 |
| 5600 | 367·90 |
| 5800 | 412·91 |
| 6000 | 466·46 |
| 6400 | 637·97 |

The values above 5800 Å are extrapolated from the graph. It is to be noted that no solar spectrum was recorded below about 3000 Å even after long exposures, in spite of the plate being sensitive up to 2000 Å This is to be expected as according to Ramnathan and Ramdas, [1] 2900 Å is the shortest wave-length of solar spectrum attainable under good conditions. This has been ascribed to the presence, in the upper atmosphere, of ozone which has got an absorption band between 2200—3200 Å. For the purpose of ascertaining the proportion of available ultra-violet radiations to the total radiations, the areas under the curve from 4000 Å to the lowest wave-length limit and under the whole curve up to 6400 Å were computed. These results are expressed below :

| Total area—under the curve—from 6400 Å. to 3000 Å. | Area under the curve from 4000—3000 Å. | Percentage of ultra-violet energy. |
|---|---|---|
| 333·73 sq. cm. | 8·11 sq. cm. | $\frac{8{\cdot}11}{333{\cdot}73} \times 100 = 2{\cdot}43$ |

It would be interesting to extend these observations so as to obtain readings at different periods of the day and in different seasons. It is intended to continue the work in these directions.

The authors are much indebted to Prof. G. R. Paranjpe for suggesting the problem, and to the authorities of the Science College, Patna, for allowing the use of their microphotometer and for the kind hospitality they extended to two of us during our stay in Patna.

## REFERENCES.

1 Ramanathan and Ramdas : *Proc. Ind. Acad. Sc., A*, 8, 308 (1934).