change which runs fairly concurrently with that noted in the magnetic and solar curves similarly treated. I was Dr. Moos's assistant at Bombay in 1910 when the volumes were published. As time permitted I tried the 11-year smoothing process on other stations and found correlation coefficients of the smoothed means with similar smoothed means of sunspots. The stations selected, the values of the correlation coefficients, and the number of years made use of, are given in the following table :

| | Tokyo. | Batavia. | Port Darwin. | Calcutta. | Madras. | Bombay. | Eniseisk. | Greenwich. | Abbassia (Cairo). | Cape Town. | Mauritius. | Charleston. | Santiago. | Cordoba. | Buenos Aires. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Correlation coefficient . | −0·65 | −0·59 | −0·61 | −0·61 | −0·27 | −0·37 | +0·03 | −0·23 | −0·61 | −0·63 | +0·14 | +0·10 | +0·32 | +0·50 | +0·73 |
| No. of years . . . . | 47 | 55 | 43 | 55 | 55 | 55 | 50 | 55 | 52 | 55 | 50 | 52 | 55 | 52 | 55 |

At 6 out of the 15 stations selected the values of the correlation coefficients exceed 0·6, and the positive relationship at the South American stations is significant.

In *Indian Meteorological Memoirs,* Vol. 21, Part XII, published in 1915, on sunspots and pressure, by Sir Gilbert Walker, correlation coefficients between the annual means of sunspots and pressure are given for some 90 stations over the globe. There are only

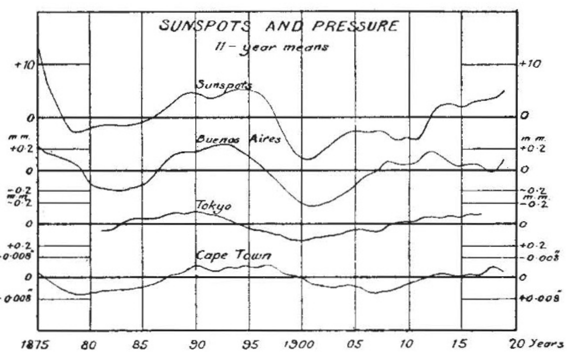


FIG. 1.

three values rising above 0·4, in two of which the number of years is only 20 or 22. The largest value, − 0·47, is for Cape Town record for 55 years.

It is probable that irregularities due to various causes mask the relationship from year to year, and the 11-year smoothing process may be fruitful in leading one to the true nature of the relationship.

Curves for sunspots and for pressure at three significant stations are charted in the accompanying diagram (Fig. 1) for exhibiting the parallelism. The period embraces 5 sunspot cycles. The amplitude of the pressure range is about 0·4 mm.

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**Properties of the $He_2$ Rotation Terms.**

THE analysis of the band spectrum of helium is now nearly complete. The great majority of the stronger lines have been allocated to bands, of which some sixty have now been recognised. The remaining lines may be attributed to (1) higher members of the electronic sequences already known, (2) electronic levels of a new type, and (3) vibrational levels.

In connexion with (1) a special difficulty arises, apart from the relative faintness of the lines, in that most of the bands suffer very considerable changes as the principal electronic quantum number, $n$, increases. Not only may the appearance of a branch entirely change (from $R$ to $Q$, say), but it may fade out entirely. In some cases a band which has all three branches present for $n=3$ is reduced to a single branch ($R$, but of $P$-form) when $n=6$. The usual method of procedure, by searching for combination relationships, is then impossible, and the correctness of the interpretation proposed must remain in doubt.

The difficulty can be surmounted, in this spectrum at least, by consideration of certain regularities which are exhibited by the rotation term differences of the various electronic states. These are briefly as follows :

(1) With increasing $n$ the differences tend to reach constant values, which in many cases may be estimated to within about 1 cm.$^{-1}$.

(2) These limiting values are identical, not only for all the terms in one system, but also for both singlet (par) and triplet (ortho) systems. They are approximately

71 127 183 239 294 347 399 450 cm.$^{-1}$
for $(j-\rho)=$ 2 4 6 8 10 12 14 16

These are evidently the rotation term differences of the $He_2^+$ ion, and correspond to odd values of $(j-\rho)$, the even values being missing, in agreement with theory.

(3) The $\rho$ values associated with each electronic state follow at once from the above data, and agree throughout with those proposed by Dieke (NATURE, vol. 123, p. 716, 1929), except that for his $p_b$ states $\rho=+1$ instead of $-1$ as given in his table.

It is unnecessary to give here a full description of the regularities found, but they are such that most of the rotation terms at present missing can be predicted within a few cm.$^{-1}$; conversely, the interpretation of new bands is greatly facilitated. Thus, for example, two new branches of $P$- and $Q$-form recently found by Dieke, Takamine, and Imanishi (*Zeitschr. f. Phys.*, **54,** 826 ; 1929), but not identified, are easily recognisable by this method as $Q$ and $R$ branches of the $6X$ level of ortho-$He_2$. Even single branches may now be interpreted, provided that the final electronic state is known, since it is possible to derive a set of initial term differences by combining the known final term differences with the intervals between successive lines in the branch. These differences, if genuine, will fit into the scheme and their designation will be apparent.

It is clear that this method will be of very great assistance in resolving the last complexities of the $He_2$ spectrum. It will be interesting to see whether it is applicable to other band spectra, and in particular to that of hydrogen.

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