made of (*a*) total nitrogen of plants alone, and (*b*) total nitrogen of nodules alone. The increase of (*a*) with time is a measure of the rate of transfer of fixed nitrogen into the plants from their nodules, while the increase of the sum of (*a*) and (*b*) gives an index of the rate of fixation of atmospheric nitrogen by the bacteria associated with the plants.

The results reveal the existence of a definite quantitative relation between fixation and transfer. Throughout practically the whole life cycle of the host, the rate of transfer was persistently 80–90 per cent of the rate of fixation. During the first experimental period in which fixation occurred, as great a proportion of the nitrogen fixed was transferred out of the nodules as during the succeeding periods, indicating that there is little tendency for the products of fixation to be retained within the bacteria for a time before becoming available to the host.

These results favour the theory of excretion, for it is feasible that a roughly constant proportion, apparently 80–90 per cent, of the fixed nitrogen should be excreted by the bacteria with little delay, and be taken over by the plant. On the other hand, transfer by digestion seems unlikely to produce the above quantitative relation between transfer and fixation, but would necessitate a lag in time between the two processes.

In the final experimental period, transfer exceeded fixation, but the very low rate of transfer during this period indicates that no accessory transferring mechanism of any importance came into operation towards the end of the host life cycle.

Certain points are being confirmed prior to publication of full results.

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Spectrum of the Night Sky and of the Zodiacal Light

IN a recent paper[1], one of us has described the general nature of the spectrum of the night sky as observed in India, and pointed out that besides the green line 5577 A. originating in atomic oxygen, there are many other lines which have also to be considered as general characteristics of the spectrum of the night sky at all latitudes of the earth. As has been emphasised by Lord Rayleigh, this spectrum is quite distinct from that of the polar aurora; the second negative bands of nitrogen (N_2^+) which are a conspicuous feature of the spectrum of the polar aurora, are absent or only very faintly present in the night sky spectrum.

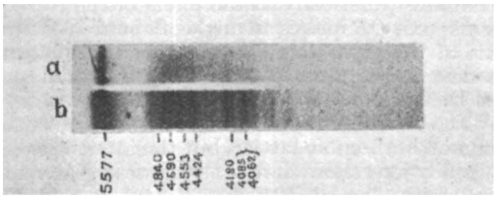

FIG. 1. Spectrum of (*a*) zodiacal light plus night sky; total exposure, 27 hours; (*b*) night sky; exposure, 75 hours.

During the early part of this year, we succeeded in obtaining exceptionally well-exposed spectra both of the night sky and of the zodiacal light at Poona. Fig. 1, which was obtained with the spectrograph described in the paper referred to above, shows both the spectrum of the night sky (below) and that of the zodiacal light (above). The exposure for the night sky was towards the north at an angle of 20° above the horizon and lasted 75½ hours (April 12–29, 1933), while for the zodiacal light it was mostly towards the west sky at the same angle and of duration 21½ hours. (By an unfortunate oversight, the zodiacal light had superposed on it an additional 5¾ hours' exposure towards the north sky.) The night sky spectrum shows besides the 5577 line, more than thirty 'lines' between 5900 A. and 3700 A., two of which are on the red side of 5577 A. The strongest 'lines' occur at 4840, 4690, 4553, 4424, 4180 and 4085 A. and the photographically brightest region of the spectrum lies between 4830 and 4530 A. The spectrum of the zodiacal light also shows the emission lines or bands observed in the night sky. The plate used—Mimosa orthochromatic—was not sensitive to the red.

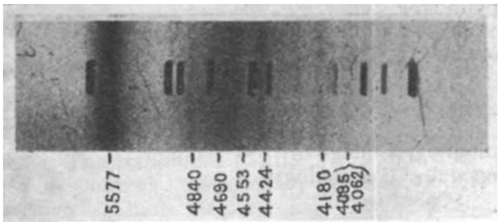

FIG. 2. Spectrum of night sky; exposure, 181 hours; comparison spectrum, helium.

Fig. 2 shows a spectrum obtained with a spectrograph of higher dispersion (11·4 mm. between 5876 A. and 3900 A.). The exposure lasted 181 hours between March 7 and May 1, 1933. From a comparison with the spectrum of the night sky observed by Dufay[2] in France, it is seen that there is almost an identity between the spectra as observed in India and in France, both as regards the position of the lines and their relative intensities.

It is generally held that the spectrum of the night sky contains a background of continuous spectrum with Fraunhofer lines. In the spectra we have obtained, there is no positive evidence of the existence of Fraunhofer lines.

A fuller discussion of the spectra will be published elsewhere.

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[1] *Ind. J. Phys.*, 7, 405; 1932.
[2] *J. Phys.*, Ser. 7, 4, 221; 1932.

Fluorination of Organic Compounds: Monofluoracetone

IN continuation of the work already described[1] we have recently prepared monofluoracetone. Interaction of monochloracetone and anhydrous thallous fluoride gave negative results. On converting, however, the chloro-compound into the corresponding iodo-derivative and refluxing with anhydrous thallous fluoride in presence of ether, the expected monofluoracetone has been isolated. Swarts[2] has described $CF_3.CO.CH_3$ (trifluor-acetone), the boiling point of which is given as 21·9° C., the boiling point of trichloracetone at 764 mm. being 149° C. The substitution of three chlorine atoms by three fluorine atoms lowers the boiling point by 127°; that is, on the average, by the substitution of one chlorine by one fluorine, the lowering of boiling point is 42°–43° C. In the present preparation, the difference between the boiling point of monochloracetone (118° C.) and of monofluoracetone (72° C., uncorrected) is 46, which is not far off Swarts's results.

Further investigation on these lines on the preparation of fluorinated aldehydes and other analogous compounds is in progress.

It appears that TlF may be used as a fluorinating agent in cases of certain halogen substituted organic compounds.

The details will appear in due course in the *Journal of the Indian Chemical Society.*

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[1] NATURE, 132, 173, July 29, 1933.
[2] *Bull. Classe des Sci.*, 5, 13, 175.

X-Ray Spectra in the Region 50-250 A.

Using the concave grating methods previously described[1], we have now been able to follow the *L*-series of the X-ray spectra down to element No. 12 (Mg). For this element, the *M*-shell consists of only the two valency electrons. The *L*-series had formerly been measured by several authors down to element No. 20 (Ca) with the plane grating method; one separate line belonging to this series was found by Prins and Takens[2] for element No. 16 (S).

The plates for elements Nos. 19 (K) and 17 (Cl) show for each element a nice doublet with very sharp lines measurable in many orders. Also at element No. 16 (S) the corresponding sharp doublet was found when a sulphate was placed on the anticathode. With pure sulphur on a copper anticathode, two rather strong and diffuse lines were obtained, one on the shorter and one on the longer wave-length side of the sharp doublet. Element No. 15 (P) gives a group of five rather broad lines in the region 98–118 A. Elements 14 (Si), 13 (Al) and 12 (Mg) show very broad lines with a sharp limit on the short wave-length side. This limit, at 126, 170 and 250 A. respectively, seems to correspond to the absorption edge. This phenomenon may be interpreted as emission due to transition of electrons from the free levels of the crystal grating to an empty inner level. Quite an analogous structure is found in the K-series of the lighter elements, especially of element No. 4 (Be).

In addition to the more prominent lines mentioned above, the plates show several other lines belonging to these elements. A detailed report will be given elsewhere.

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Oct. 16.

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[1] M. Siegbahn, *Proc. Phys. Soc.*, 45, 689; 1933.
[2] J. A. Prins and A. J. Takens, *Z. Phys.*, 77, 795; 1932.

Structure of Chrysene and 1:2:5:6-Dibenzanthracene in the Crystalline State

The exact crystal analysis of these two compounds is of importance owing to the fundamental position occupied by the chrysene type of carbon skeleton in sterol and œstrin chemistry on one hand, and to the carcinogenic properties of dibenzanthracene on the other[1].

Following the complete determination of the anthracene and durene structures[2], the obvious method consists of basing plane hexagon models on the chemical structure and endeavouring to obtain agreement between the measured and the calculated structure factors.

Chrysene crystallises in the monoclinic system with $a = 8{\cdot}34$, $b = 6{\cdot}18$, $c = 25{\cdot}0$ A.; $\beta = 115{\cdot}8°$. The general planes are halved when $h + k + l$ is odd, and all the (*hol*) planes are halved. The space group is therefore C_{2h}^{6} or C_{s}^{4}, but the analysis given below indicates the former. Each of the four molecules in the unit cell may thus be assumed to have the centre of symmetry permitted by the chemical formula. The centre of the reflected (or rotated) molecule might lie either half-way along the *a* or half-way along the *c* axis, but the strong reflections from the (035), (037), (0315), (0317), etc., conclusively indicate the latter alternative.

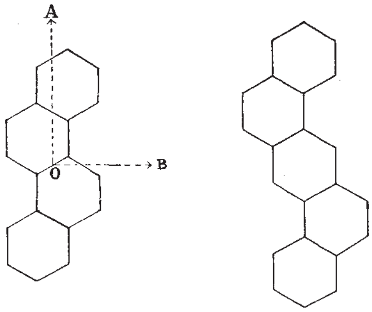

Fig. 1.

Assuming a planar molecule of the anthracene type (carbon to carbon distance, 1·41 A.), the following orientation has been found, which leads to good agreement between the measured and calculated values of about eighty structure factors. The long axis of the molecule *OA* (Fig. 1) is tilted about 10° away from the normal to the (001) towards the *c* axis, but remains practically in the plane of the (010), and the cross axis *OB* makes an angle of about 16° with the *b* axis of the crystal. The plane of the molecule is thus near to the $(20\bar{2})$ plane, which is found to give much the strongest reflection observed in the crystal.

1:2:5:6-Dibenzanthracene has a face centred pseudo-orthorhombic lattice, but the intensities of the (*hol*) reflections show that the system is really monoclinic with $a = 6{\cdot}59$, $b = 7{\cdot}84$, $c = 14{\cdot}17$ A.; $\beta = 103{\cdot}5°$. The only halving is the (010), so that the space group is C_{2h}^{2} or C_{2}^{2} with two molecules per unit cell. The strong tendency for the crystals to develop on the (001) plane in the form of very large thin flakes makes the accurate measurement of intensities a difficult matter, but the enhancement of certain orders such as the (0013), and some of the (*hk*6) and (*hk*7) reflections, together with the cell dimensions, are sufficient to show that the molecules again stand nearly upright on the (001) plane. Much the strongest reflection from the crystal is given by