

the vertical plates of its cathode ray oscillograph, while the horizontal plates were connected in common to the output of the local 1 khz fork apparatus; the resulting image on the screen was quickly traced by hand on a piece of clear tracing paper. Observations were hampered considerably by a rather unexpected source of trouble in the form of a continuous current motor used for pumping water. The announcements could not be made out at all.

The test oscillator modulated at 1 khz from a local tone generator was used in gaining experience in adjustment.

The pattern on the screen was, in general, a somewhat distorted ellipse on both 804 and 1050 khz; neither its shape nor its size was constant for more than a few seconds at either frequency (Figs. 2 and 3). The variations were more pronounced and rapid at the higher frequency than at the lower, particularly on 12th morning. In view of the location of the two transmitters at the same site in Scotland and the accuracy and high stability of the frequencies of the Institute and the NPL forks, the above would indicate that the variations in the figures observed on the oscillograph screen were due to the ionospheric transmission path in respect of intensity and of phase, that is, path difference. The local 1 khz voltage across the horizontal plates of the oscillograph with the 1050 khz receiver output across its vertical plates was replaced by the output from the 804 khz receiver; but the signals were so feeble that no clear diagram was obtained on the screen. The modulating frequency for the subsidiary emissions earlier in the morning on 13th March differed from that of the main emissions by only a few points in a million or less.

In spite of the distance of Bangalore from the transmitters and of the severity of electrical disturbances, more satisfactory observations and even measurements would probably have been possible if the programme of transmission had started about an hour earlier. Alternatively, modulation of some of the short wave transmitters might have enabled useful observations notwithstanding severe fading at these hours.

At the southern end of Bangalore, about 4 miles from the Institute Mr. N. Srinivasa Row "listened in" on 1050 khz using the excellent super heterodyne receiver owned by Sir M. N. Krishna Row. Atmospheric disturbances and fading were present but

little of any "man made" disturbances. The announcements could be made out but somewhat incompletely. The 1 khz emission was heard; but as the morning proceeded, the signal got weaker; after about 0730 IST, nothing came out of the receiver except disturbances.

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The apparatus arrangements and the observations were all made by Messrs. B. V. Baliga, T. D. Chatterji, T. Krishnaswamy Rao, S. N. Mukerji, K. Raghunatha Rao and T. V. Rama Murthy of the Electrical Communication Engineering Section of the Department of Electrical Technology of the Indian Institute of Science, Bangalore.

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Densities of Aqueous Solutions of Formaldehyde between 20° and 40°.

AUERBACH AND BARSCHALL¹ have determined the densities of formaldehyde solutions in water at 18°. As these solutions of different concentrations are now extensively used in photography in India, their densities have now been determined at temperatures between 20–40°. Thus, with the aid of an accurate hydrometer, the data given in Table I can be readily employed for determining the concentration of a given solution of formaldehyde at the usual laboratory temperatures in India.

For these determinations pure formaldehyde gas was obtained by passing a current of pure nitrogen over trioxymethylene contained in a retort heated to 180°. The gas was absorbed in distilled water kept in an ice bath and the most concentrated solution containing 42 per cent. of formaldehyde by volume was obtained. The amount of formaldehyde in the solution was estimated by the usual iodine method.

Densities were determined by a specific gravity bottle (Regnault type) which was

kept for fifteen minutes in a thermostat maintained at any desired temperature to within $\pm 0.02^\circ$. The balance weighed correctly to 0.1 mgm. and the method of double weighing was employed, correction being applied for bouyancy. A set of standard weights with N. P. L. certificate was used.

The results obtained are shown in Table I.

TABLE I.

Densities of aqueous solutions of formaldehyde in terms of the density of water at 4° C.

| Grams of formaldehyde in 100 c.c. sol. | D ₂₀ | D ₂₅ | D ₃₀ | D ₃₅ | D ₄₀ |
|--|-----------------|-----------------|-----------------|-----------------|-----------------|
| 2.76 | 1.0065 | 1.0054 | 1.0037 | 1.0020 | 1.0001 |
| 6.3 | 1.0167 | 1.0152 | 1.0136 | 1.0115 | 1.0097 |
| 11.55 | 1.0320 | 1.0303 | 1.0284 | 1.0263 | 1.0242 |
| 14.43 | 1.0403 | 1.0385 | 1.0365 | 1.0344 | 1.0321 |
| 19.3 | 1.0552 | 1.0531 | 1.0510 | 1.0486 | 1.0462 |
| 25.26 | 1.0703 | 1.0681 | 1.0658 | 1.0633 | 1.0606 |
| 30.9 | 1.0859 | 1.0835 | 1.0808 | 1.0782 | 1.0754 |
| 37.35 | 1.1013 | 1.0987 | 1.0961 | 1.0933 | 1.0904 |
| 41.43 | 1.1126 | 1.1099 | 1.1071 | 1.1042 | 1.1019 |

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February 26th, 1935.

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¹ Arbeiten aus dem Kaiserlichen Gerandtheit samte.—Zweiundzwanzigster Band, 1905.

Culture of Micro-Organisms on Cellophane Membrane.

IN the course of our studies on the mechanism of nitrogen fixation, it was found necessary to obtain considerable quantities of bacterial (azotobacter) growth free from the solid constituents of the culture media. By covering the solid medium with cellophane membrane, it was thought that the crystalloidal constituents comprising the greater portion of the nutriment, would permeate through the membrane and be made continually available to the growth of the bacterium while the solid medium underneath would, as usual, serve as the reservoir of nutrients and water.

The experimental technique consisted in covering the surface of the solid medium (after setting in a petri-dish) with a sterile strip of moistened Cellophane, so that the membrane was in intimate contact with the surface of the medium. (Cellophane supplied by the British Cellophane Company is used and it could be sterilised by heating it in an autoclave at 15 lbs. pressure for 15 minutes). The dish was inoculated in the usual manner. The organisms grew quite well on the media and the growth was found practically as satisfactory as the growth on plain, uncovered media. When sufficient growth had occurred, the membrane was lifted out of the dish and the bacterial growth easily recovered from the membrane.

The technique has now been successfully extended to other aerobic organisms. Attempts are also being made to apply the method to strict anaerobes and to such parasites as normally grow only in association with their hosts.

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Synthesis of Pinonic Acid.

PINONIC acid was obtained for the first time by Wagner and Ertshikowski¹ by the oxidation of α -pinene which contained some verbenone or verbenol, and later on Kerschbaum² and Blumann and Zeitschel³ got the same by oxidising verbenone. Fromm and Autin⁴ obtained the same acid by the oxidation of olibanol the constitution of which is not yet definitely known. The establishment of the constitution of verbenone, depends entirely on the synthesis of pinonic acid. This has now been achieved in the course of our attempts to synthesise pinene and verbenone starting from norpinic acid.

trans-Norpinic acid prepared according to the method of Kerr⁵ with slight modifications, was converted into the *cis*-anhydride in an yield of 80-85 per cent. of theory by heating it with acetic anhydride in a sealed tube at 190-200°. This on being treated with an equimolecular quantity of sodium methoxide in methyl alcohol gave the sodium derivative of *cis*-norpinic acid monomethyl ester (I) in almost quantitative yield.