

near Bikaner. The bed of lignite which varies in thickness from a few inches up to 8 feet is overlain by a thick bed of Nummulitic Limestone. Lignite samples and the Nummulitic limestones were collected by S. S. Misra in 1918 from a section at Palana described by La Touche.⁹ The bed of Nummulitic limestone contains *Assilina spinosa* and *A. daviesi*, but *A. granulosa* is, however, not present. The Palana Limestone correlates with the Bhadrar beds, the highest Laki beds of the Salt Range and the underlying lignite is also probably Eocene in age, but no marine organisms were noticed. The lignite is made of lumps of resin, carbonised wood, cuticles, and spore exines (which are being studied by Dr. A. R. Rao).

A specimen of the alga recovered from macerations is shown in the accompanying photo. Each colony is more or less spherical in form with a central cavity surrounded by a zone of cells. Usually several colonies coalesce into a compound colony. The alga is oily-looking light yellow in colour, (a few are greenish), well-preserved and resembling *Botryococcus braunii* in structure and dimensions.

A detailed account of the Palana alga will be published elsewhere.

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COUMARINS AS NEW INDICATORS IN ACIDIMETRY AND ALKALIMETRY

HYDROXY-COUMARINS undergo colour changes at different pH values, e. g., 5-hydroxy-coumarins in alkaline solution¹ turn yellow, the colour being discharged on acidification: similarly, 7-hydroxy-coumarins exhibit blue fluorescence, which disappears on adding acid.

5-Hydroxy-6-acetyl-4-methyl coumarin² has been selected for investigating its use as an indicator. Alkalimetry turns it deep yellow, while it remains colourless in acids. Its 0.1 per cent. alcoholic solution has been used throughout this work. Various acids, and alkalies (HCl, H₂SO₄, HNO₃, succinic acid NaOH, KOH, Na₂CO₃) were titrated using the above solution as an internal indicator, two to three drops being added. The change in the colour of indicator was quite sharp. In all the titrations 5-hydroxy-6-acetyl-4-methyl-coumarin as an indicator gave results closely analogous to those for phenolphthalein.

Further work on the utilisation of other 5-hydroxy- as well as 7-hydroxy-coumarin derivatives is in progress.

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VANADAMETRY—PART IV

Volumetric Estimation of Hydroquinone by Sodium Vanadate

In the reaction between hydroquinone and sodium vanadate, diphenyl benzidine serves as an excellent indicator at 50° C. in presence of oxalic acid as catalyst. 10.0 ml. of 0.05 M hydroquinone solution were taken and diluted to about 150 ml. followed by the addition of 5 ml. of 15 N sulphuric acid and 1.0 ml. of 0.1% indicator. To the mixture at 60° C., a known quantity of oxalic acid added. Then an equivalent Volume of 0.05 N vanadate solution (with a drop in excess) was added with brisk stirring and the time taken for the appearance of the blue-violet colour was noted. Experiments were carried out, varying the concentration of oxalic acid. The results are recorded in Table I.

The data show that diphenyl benzidine serves as a good indicator in the presence of oxalic acid at or above a concentration of 0.01N. We have also found that the end point will be sharply indicated when the overall concentration of hydroquinone

TABLE I

Volume of 1.0 N oxalic acid	Nil	0.25 ml.	0.5 ml.	0.75 ml.	1.00 ml.	1.5 ml.	2.00 ml.	3.00 ml.
Time of first appearance of blue-violet colour in the cold	No colour even after 10 minutes	45 sec.	45 sec.	42 sec.	40 sec.	35 sec.	30 sec.	30 sec.
Time of first appearance of blue-violet colour at 60° C.	Very faint blue-violet colour after 8 minutes	5 sec.	5 sec.	4 sec.	4 sec.	3 sec.	3 sec.	3 sec.

is under M/100 and the acid concentration is over 1.0 N. The results in Table II show that the vanadometric method gives results in agreement with the ceric sulphate method.¹

TABLE II

Amount of hydroquinone in milligram mols.

No.	By weight	Ceric sulphate method	Vanadometric method
1	0.5000	0.4982	0.4994
2	0.4000	0.3980	0.3986
3	0.3653	0.3640	0.3638
4	0.3000	0.2989	0.2993
5	0.7306	0.7275	0.7290
6	0.5480	0.5466	0.5465

Although ceric sulphate is a convenient reagent for the estimation of hydroquinone, it is unsuitable for use in the presence of phenolic compounds, since it oxidises these phenols to coloured substances insoluble in sulphuric acid. We have now found that sodium vanadate gives accurate results even in the presence of phenol, *ortho*-cresol, *meta*-cresol and *para*-cresol, (Table III).

TABLE III

Phenolic compound added in milligram mols.	By weight	By vanadometric method	
Phenol	2.5040	0.3653	0.3638
	5.0080	0.3653	0.3638
	10.0160	0.3653	0.3638
<i>Ortho</i> -cresol	5.000	0.3653	0.3638
	10.000	0.3653	0.3638
<i>Meta</i> -cresol	4.6660	0.3653	0.3638
	9.3230	0.3653	0.3638
<i>Para</i> -cresol	2.5040	0.5480	0.5465
	5.0080	0.5480	0.5465
	10.0160	0.5480	0.5465

Resorcinol, however, undergoes induced oxidation by sodium vanadate in the pre-

sence of hydroquinone giving a deep coloured substance.

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1. Furman and Wallace, *J. Am. Chem. Soc.*, 1930, 52, 1443.

NATURE OF ACTIVATED SLUDGE AND ITS BEARING ON DE-WATERING THE MATERIAL

ACTIVATED sludge derives its activity from its organisms of which the most important are certain ciliates, more especially *Epistylis* sp. and other *Vorticellids*. The protozoa occur abundantly, forming slimy growths tenaciously attaching to the sides of aeration tanks and other fixed and mobile surfaces, e.g., microscopic particles of more resistant forms of organic matter in the mixed liquor (Figs. 1-2). Colonial *Vorticellids* were found most efficient in "floc" and sludge formation. These organisms are sensitive to acids, alkalis and other chemicals in concentrations met with in certain trade effluents, and are readily stained by carbol fuchsin.

The protozoal growth (*Epistylis* sp.), when washed and suspended in H₂O, presents a fairly white, fluffy, mucus-like appearance and settles down rapidly and forms a compact gelatinous mass which, under anaerobic conditions, putrefies; when aerated, nitrifies forming a brownish deposit; and on oven drying, yields, a dark brown powder.

Unlike other types of sewage sludges, activated sludge is bulky, hydrophilic and richer in nitrogen. These properties are