

oxide decreases with an increase in the quantity of alkali used for precipitation. This hydration ultimately affects the chemical properties of the oxide.

Further work on hydroxides is in progress, and the results, it is hoped, will throw considerable light on such phenomena.

The author thanks Dr. S. Ghosh of the University of Allahabad for his kind interest.

Department of Chemistry, ARUN K. DEY,
University of Saugar,
Saugor, C. P.
October 24, 1948.

1. Dey and Ghosh, *J. Ind. Chem. Soc.*, 1947, 24, 181. 2. Kohlschütter and Tuscher, *Zeit. anorg. Chem.*, 1920, 111, 193. 3. Dey and Ghosh, *Nat. Acad. Sci., India, Annual Session*, 1947.

VANADOMETRY—PART II

Volumetric Estimation of Ferrocyanide Ion by Sodium Vanadate

FERROCYANIDE ion is oxidised in acid solutions readily to ferricyanide ion by a number of reagents, e.g., hydrogen peroxide, potassium permanganate, dichromate, chlorate, bromate, iodate, chlorine, bromine, iodine, ceric sulphate, etc. Many years ago De Haen¹ proposed the estimation of ferrocyanide by titration with potassium permanganate. Muller and Lauterbach² adopted the same reaction for electrometric titration. Kolthoff³ proposed an iodimetric method based on the reaction between ferrocyanide and iodine in neutral solution. Schwicker⁴ adds an excess of potassium iodate solution to the acid solution of the ferrocyanide and estimates the unreacted iodate by titration with a decinormal potassium bisulphite solution.

Recently Gopala Rao and Viswanadham⁵ and Gopala Rao and Ramanjaneyulu⁶ have found that sodium vanadate provides an excellent oxidimetric reagent which possesses some special advantages over potassium permanganate and potassium dichromate. We have now made experiments to see if sodium vanadate could be successfully employed for the volumetric estimation of potassium ferrocyanide. 5 mls. of 0.05 potassium ferrocyanide solution were taken into a beaker, diluted to about 150 ml. with distilled water and acidified with 10 ml. of about 15 N sulphuric acid. The solution

was titrated with 0.05 sodium vanadate solution, using 0.5 ml. of diphenyl benzidine solution as an internal indicator. At the end point, the colour changes from a pale green into a blue violet. We found that the colour change is sharply noticeable only when the overall acidity of the solution is above normal and the concentration of the ferrocyanide is not more than N/600. If the concentration exceeds this limit the solution must be suitably diluted. From the results tabulated below, it will be seen that the method gives accurate results under the conditions prescribed.

Amount of potassium ferrocyanide,
 $K_4Fe(CN)_6 \cdot 3H_2O$, in milligram mols.

By weight	By permanganometric titration	By vanadometric titration
0.2679	0.2682	0.2678
0.5358	0.5365	0.5356
0.8037	0.8047	0.8033
1.0716	1.0704	1.0712
1.3395	1.3417	1.3390
1.6074	1.6071	1.6092

We have also found that the estimation of ferrocyanide by vanadate can be accurately carried out even in the presence of hydrochloric acid, oxalic acid, etc., where permanganate fails. Details are communicated for publication elsewhere.

Chemistry Department, G. GOPALA RAO.
Andhra University, V. BRAHMAJI RAO.
Waltair,

and
Chemistry Department,
Mrs. A. V. N. College,
Vizagapatam,
November 20, 1948.

1. De Haen, *Ann. d. Chem. und Pharm.*, 1854, 90, 160. 2. Muller and Lauterbach, *Z. anal. Chem.*, 1922, 61, 398. 3. Kolthoff, *Chem. Weekblad.*, 1919, 16, 1406. 4. Schwicker, *Z. anal. Chem.*, 1929, 77, 161. 5. Gopala Rao and Viswanadham, *Curr. Sci.*, 1944, 13, 180. 6. Gopala Rao and Ramanjaneyulu, *Ibid.*, 1949, 18, 72.

A STUDY OF *CERCARIA FRASERI* BUCKLEY, 1939 IN MADRAS

IN the course of an investigation of the life-histories of some trematodes, a diplocotyle amphistome cercaria was found to issue from specimens of *Indoplanorbis exustus*, first on 15th September 1941 and

on many occasions subsequently, from various localities in the vicinity of Madras. The structural details which determine its taxonomic position are the heavy pigmentation, the presence of well-defined oral pouches, and independent lateral excretory canals showing dichotomy at the anterior ends. The rediæ are of the characteristic type with three pairs of flame-cells, but no locomotor appendages, and contain a second generation of rediæ, or cercariæ. When we had recourse to previous studies on this group of cercariæ, we found it possible to distinguish our form from all those of the Diplocotylea described hitherto, except *Cercaria fraseri* which Buckley (1939) obtained from the same species of snail in Assam, India, although the recurrent branch of each lateral excretory canal figured by this author is not always to be seen.

In a recent communication, Peter and Mudaliar (1948) remark erroneously that only two diplocotyle cercariæ—*Cercaria Indica* XXI Sewell, 1922 and *Cercaria kylasami* Rao, 1932—have been reported from India. Unacquainted with the literature on the subject, they further believe that their larva is new, which is not so. The characters given by them are precisely those which mark *C. fraseri*, according to Buckley's description and our own observations as well, and it is beyond doubt that they have been dealing with only *Cercaria fraseri*.

Experiments have been conducted to augment our knowledge of the biology of these cercariæ, their discharge from the snails, their encystment and behaviour in relation to environmental conditions, their association with other known amphistome cercariæ, their distribution in and away from Madras, and their host-specificity. They seem to be selective, like *Cercaria Indica* XXVI, in their intermediate host, as on no occasion was *Limnæa* from the same tanks ever observed to harbour them. *Cercaria Indica* XXVI, the larval form of *Cotylophoron cotylophorum*, has been found to be a frequent associate of *C. fraseri*.

In an attempt to obtain their adults, 5083 encysted cercariæ (*C. fraseri* and *Cercaria Indica* XXVI) were administered to a he-buffalo calf on 8th March 1946, and over 20,000 to a pigling on 16th May 1946, expecting that *C. fraseri* might grow into *Homalogaster poloniæ* in the calf or *Gastro-*

discoides hominis in the pig. Daily microscopical examination of the fæces of both was made, and since no evidence of infection in the pigling appeared it was discharged on 21st Nov. 1946. But, in the calf which had been stall-fed for many months, trematode eggs were first seen on 12th July 1946 (4 months 4 days later) and at autopsy on 11th Nov. 1946, nearly 2,000 adult amphistomes were recovered from the rumen. A small proportion of them when examined proved to be *Cotylophoron cotylophorum*, apparently grown from *Cercaria Indica* XXVI. The negative result in both animals, in so far as *C. fraseri* is concerned, is in accord with that obtained by Buckley (1939).

Buckley (1939) considers it unlikely that its adult might be *Gastrodiscus secundus*, in view of its differences from the cercaria of the nearly related species *G. ægyptiacus*. Looss (1896) draws attention to the presence, in the cercaria of *G. ægyptiacus*, of an œsophageal bulb, a distinctly different pattern of the excretory system in the body, of external pores for the excretory canal in the tail, and of locomotor appendages in the younger rediæ, all of which are absent in *C. fraseri*. If these considerations have any significance against the adult of the latter being *G. secundus*, the only other equine amphistome with oral pouches—but lacking an œsophageal bulb and commonly met with in Madras is *Pseudodiscus collinsi*.

Parasite	CERCARIA		REDIA
	oral pouches	œsophageal bulb	locomotor appendages
<i>Gastrodiscus ægyptiacus</i>	present	present	present
<i>Zygocotyle lunata</i> ..	present	present	absent
<i>Cercaria fraseri</i> ..	present	absent	absent
<i>Cercaria frondosa</i> ..	present	absent	present

Ecological factors favour yet another line of argument. The frequent occurrence of *C. fraseri* in companionship with *Cercaria Indica* XXVI (the larva of *C. cotylophorum*) in the same, or in different, specimens of *Indoplanorbis exustus*, and occasionally with *Cercaria Indica* XXIX (the larva of *Fischœderius elongatus*) in *Limnæa* from the same tanks, strongly suggests that its host may also be a domestic ruminant. This possibility is further supported by the

record of *C. fraseri* from a tank of the Hosur Cattle Farm which could have been visited only by cattle, sheep or goats among the large animals. However, this cannot eliminate the possibility of a parasite of monkeys, aquatic birds or lower water vertebrates occurring in such places, since these hosts could contaminate even confined waters. In that event, the adult parasite is probably a Cladorchid amphistome of the kind that has pharyngeal pockets without an œsophageal bulb.

In the light of these conflicting evidences, and of the misleading observations made on *Cercaria Indica* XXVI before it was proved to be the larva of *C. cotylophorum*, it would seem expedient to conduct carefully controlled experiments for determining the adult of *C. fraseri* conclusively.

This preliminary discussion will be published in detail elsewhere.

M. ANANTARAMAN.

G. BALASUBRAMANIAM.

Helminthology Research Section,
Madras Veterinary College,
December 21, 1948.

-
1. Buckley, J. J. C., *Journ Helm.* 1939, 17, 25
 2. Looss, A., *Mem. L'Inst. Egypt.*, 1896, 3, 1.
 3. Peter, C. T., and Mudaliar, S. V., *Curr. Sci.* 1948, 17, 303.
 4. Rao, M. A. N., *Ind. Journ. Vet. Sci. and Anim. Husb.*, 1932, 2, 259.
 5. Sewell, R. B. S., *Ind. Journ. Med. Res.*, 1922, 10 (Suppl.), 1.

LIFE-HISTORY, BIONOMICS AND CONTROL OF SWEET POTATO WEEVIL—*CYLAS FORMICARIUS* F. IN BOMBAY PROVINCE

SWEET POTATO is regarded an important vegetable both because of its keeping quality and its food value. Of 12,928 acres under sweet potato in Bombay Province (1946-47) about 55% of the area is concentrated in the districts of Belgaum, Satara and Sholapur only. Of the various pests, namely, *Aspidomorpha miliaris* F., *Diacrisia obilqua* W. and *Cylas formicarius* F., attacking this crop the last one is a major pest, which is very widely distributed and causes great damage to the sweet potato tubers as well as to the mature stems.

Systematic investigations on this pest therefore, were started in 1947 at Padegaon Research Station. with a view to studying

its life-history, bionomics and control since its damage seemed quite alarming and information of any practical utility was not available in this country. The incidence of attack by this pest to the tubers alone extended upto 59.9% in an area where the crop was repeatedly grown. Apart from the damage done to the tubers, the weevils cause considerable damage to the mature stems of the vines within which the larvæ tunnel and arrest the vigour of the plants. The average number of developed stages per foot of the draws of the vines, varied from 1.5 to 3.3 while the maximum number of developed stages found in a single tuber of the dimensions 16.5×4.3 cm. was 65 out of which 44 were larvæ, 11 pupæ and 10 adults.

The nature and extent of damage, the life-history and the seasonal history have been studied and some of the control measures tried. Experiments to study the effects of manuring and irrigation on the relative infestation of the pest indicated that with somewhat heavy manuring and irrigation at an interval of 7 days, the percentage of infestation in the tubers was 3.02 which was the lowest as against the highest percentage of 17.2 in the plots with normal manuring and delayed irrigations at fortnightly intervals. The percentage of infestation with normal manuring and normal irrigation of 10 days' interval was 8.7. The incidence of attack in relation to other cultural treatments as date of sowing and spacing, etc., was also studied and on the whole, the red variety of sweet potato seems to be more susceptible to weevil attack than the white one.

The duration of life-cycle may occupy 23 to 45 days with the egg-stage lasting for 5-10 days, the larval stage 14-24 days and the pupal stage 4-11 days. The longer durations however, are met with in winter. The pest breeds throughout the year and deposits its small, oval, whitish eggs singly, both in the mature stems and within the tubers when they are formed. The larvæ and pupæ are found both in the stems and tubers. The freshly emerged adult weevil stays for a couple of days within the larval tunnel before it comes out. Usually the males outnumber the females and their percentage throughout the year vary from 53.4 to 67.0. No alternate host-plant has been recorded