The actinomycin produced by *S. parvullus* behaves in our solvent system as a homogeneous substance and, since it is therefore different from any other actinomycin hitherto reported, we have proposed for it the name actinomycin D. Full details of the preparation and properties will be reported at the Symposium on Antibiotics, Washington, D.C., in Oct. 1954.

Whether those components from different actinomycins that have the same Rf value are, in fact, identical substances is at present under investigation. In view of the possible influences of the composition of the broth and the method of isolation on the proportion of the components present in each actinomycin, we have not assigned a distinguishing letter to the actinomycin produced by strain 3491.

We wish to express our appreciation to M. Tischler, of Merck & Co., who supplied the sample of authentic actinomycin A and the actinomycin from Merck strain 6009, to J. A. Aeschlimann of Hoffman LaRoche for actinomycin B, to the Northern Regional Research Laboratories for the *S. chrysomallus* culture, and to Dr. van der Laan of the Kon. Ned. Gist and Spiritusfabrik of Delft, Holland, for the actinomycin from strain 3687. The remaining actinomycins were isolated in this laboratory, and we are indebted to R. A. Manaker and F. J. Gregory for the preparation of many of the samples.

References and Notes

1. S. A. Waksman, *Antibiotics & Chemotherapy,* **4**, 502 (1954).
2. H. Brockmann and N. Pfennig, *Z. physiol. Chem.* **292**, 77 (1952).
3. H. Brockmann, *Angew. Chem.* **66**, 1 (1954).
4. H. Brockmann and A. Bohne, *Naturw.* **41**, 65 (1954).
5. H. Brockmann and H. Gröne, *Naturw.* **40**, 222 (1953); H. Brockmann, H. Linge, and H. Gröne, *ibid.* **40**, 224 (1953).
6. D. H. Peterson and L. M. Reinecke, *J. Am. Chem. Soc.* **72**, 3598 (1950).
7. The work reported in this paper was carried out under a grant from the Dorothy H. and Lewis Rosenstiel Foundation.
8. Deposited in the Rutgers Institute of Microbiology culture collection under this number.
9. S. A. Waksman and F. J. Gregory, *Antibiotics & Chemotherapy,* in press.

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Polarography with a Dropping Gallium Electrode

Paul A. Giguère and D. Lamontagne

Department of Chemistry,
Laval University, Quebec, Canada

The universal and almost exclusive use of the dropping mercury electrode in polarography depends on the unique properties of this metal. Gallium being the only other metal still liquid at ordinary temperature (mp 29.7°C), it could conceivably serve in a dropping electrode; however, its other properties are quite unsuited for that purpose, as was confirmed by the present unsuccessful attempt. Not only is gallium scarce and expensive, but also it is readily oxidized in air. The oxide coating, which in the solid prevents further oxidation, is continuously renewed in the molten state. As a result, liquid gallium wets glass, a condition most objectionable in a dropping electrode. Furthermore, it is less than half as dense as mercury, and its hydrogen overvoltage is quite small. Finally, it expands on freezing, as do antimony and bismuth.

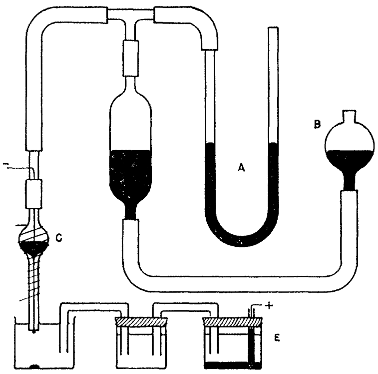

Fig. 1. Experimental arrangement of the dropping gallium electrode and electrolysis cell.

Since only about 4 ml (25 g) of metallic gallium, 99.99-percent pure (*1*) was available, a special capillary electrode was needed (Fig. 1). The capillary itself (bore diameter about 0.05 mm) had a small bulb *C* of some 10-ml capacity blown at a short distance from the tip to hold the supply of gallium; electric contact with this was secured through a fine platinum wire *D* sealed at the top. To make the liquid metal flow from the electrode, air pressure had to be applied over it by means of a leveling bulb *B* and a mercury reservoir. Although liquid gallium supercools readily, the polarographic cell was kept at 30°C in a constant temperature bath, and the electrode was wound with electrically heated resistance wire. The reference electrode *E* (saturated calomel) was of the external type to prevent the dropping gallium from mixing with the mercury of the anode. For working in absence of dissolved oxygen, some sodium sulfite was added to the electrolyte (0.1N KCl). The electric resistance of the entire circuit was about 2000 ohms. The current-voltage curves were recorded with a Sargent Model XI polarograph.

Despite all precautions, this gallium electrode always behaved erratically, especially with regard to dropping rate. This could never be reproduced from one run to the other with a given applied pressure. Therefore the figures in Table 1 must be taken only as a rough indication. Because the density of gallium is less than half that of mercury, while its surface is about 50 percent greater, one could expect that the drops falling from a certain capillary would be much larger than those of mercury; actually a factor of about 5 was observed. For the same reasons, the current intensity was proportionally higher. The measured rate of flow of gallium through the capillary electrode was appreciably greater than that calculated with the well-known equation (*2*) based on Poiseuille's

Table 1. Characteristics of mercury and gallium dropping from the same capillary; $r^4/l = 1.13 \times 10^{-12}$ cm^3 for the capillary.

Characteristics	Mercury		Gallium	
	Air	0.1*N* KCl	Air	0.1*N* KCl
P (cm Hg)	14	14	24	24
W (mg)	32.3	4.84	72	11
t (sec)	4.77	0.71	26	3.8
m (mg sec^{-1})	6.76	6.82	2.8	2.8
$m^{2/3}t^{1/6}$	4.53	3.35	3.1	2.3
P/m	2.06	2.06	19	19
v ($\times 10^{-3}$ ml)	2.38	0.36	12	2

law. On substituting the appropriate numerical values for the coefficient of surface tension, 600 dynes cm^{-1}, and the coefficient of viscosity, 2.09 centipoises (*3*), the equation becomes

$$m = \frac{6.84 \times 10^8 r^4}{l}\left(h' - \frac{7.9}{m^{1/3}t^{1/3}}\right),$$

where h' is expressed in terms of centimeters of gallium. In general, the drop time seemed to vary much more with the applied voltage than in the case of mercury, although the electrocapillary curves of both metals have about the same shape (*4, 5*). Also the size of capillary bore capable of producing reasonable rates of flow was found to be rather critical.

The only current-voltage curve that could be fairly well reproduced was obtained with an air-saturated 0.1*N* KCl solution (Fig. 2). It shows the following features: the dropping gallium electrode has a potential of −1.0 v (versus saturated calomel electrode) as indicated by the value of applied emf at zero current. Thus it is anodically polarized at lower applied voltage. The portion of the curve corresponding to that region is quite similar to that for mercury with the difference that the current intensity is much greater, as explained in the preceding paragraph.

On the cathodic polarization side, a fairly well defined wave occurs with a half-wave potential of −1.26 v.; the current at that point was of the order of 30 µamp. Since that wave disappeared entirely in an oxygen-free solution, it corresponds probably to the reduction of the gallic ions produced by reaction of the metal with dissolved oxygen. This conclusion is borne out by the fact that the cathodic half-wave potential is the same as that of the gallic ion (*6, 7*). Beyond −1.6 v, the current increased sharply owing to hydrogen evolution. Because of the numerous difficulties encountered, no attempt was made to study the reduction of other metal ions at the dropping gallium electrode.

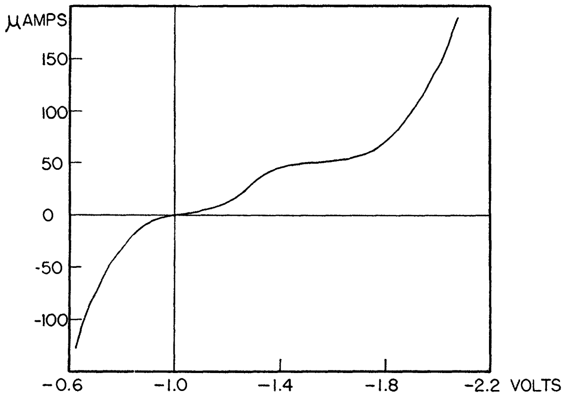

Fig. 2. Current-voltage curve for the dropping gallium electrode in air-saturated 0.1*N* KCl solution.

References and Notes

1. Kindly loaned by the Aluminum Company of America.
2. I. M. Kolthoff and J. J. Lingane, *Polarography* (Interscience, New York, 1941).
3. M. K. Srinivasan, *Phil. Mag.* **32**, 253 (1941).
4. A. N. Frumkin and A. Gorodetskaya, *Z. physik. Chem.* **136**, 215 (1928).
5. A. M. Murtazaev and A. Gorodetskaya, *Acta Physicochim. U.R.S.S.* **IV**, 75 (1936).
6. G. Challenger, Ph.D. thesis, Harvard University, 1945.
7. We are grateful to J. J. Lingane for bringing to our attention the unpublished results of Challenger and for suggesting the explanation given here.

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Identification of the So-called "Lard Factor" as Vitamin A*

Stanley R. Ames and Philip L. Harris

Research Laboratories, Distillation Products Industries,
Division of Eastman Kodak Company,
Rochester 3, New York

Discovery of a new vitamin was announced by Kaunitz, Slanetz, and Johnson in 1950 (*1*). It could be concentrated by molecular distillation of freshly rendered lard and was designated the "lard factor." The scope of this claim was subsequently modified, and reports from the same laboratory (*2–5*) showed that the disease described was simply classical vitamin-A deficiency. The new factor was then considered to be a substance possessing biological activity of vitamin A but differing chemically from known forms of vitamin A. The content of vitamin A was claimed to be less than 10^{-7} g per gram of distillate (0.33 IU/g) as the result of analyses by the usual chemical and spectrophotometric methods.

Lowe, Morton, and Harrison (*6*) and Lowe and Morton (*7*) bioassayed a similar lard distillate and found approximately 10 IU of vitamin-A activity per gram. They reported that "Neither preformed vitamin A nor carotenoid provitamin A could be detected by spectrophotometric or colorimetric tests on lard or lard unsaponifiable matter before or after chromatography, or on lard distillate," and concluded that the existence of the "lard factor" was confirmed.

Conversely, Engel (*8*) reported no indication of the presence of a "lard factor" in fresh lard that he fed to vitamin-A-depleted rats at a 10-percent level in the diet. Recently Herb, Riemenschneider, Kaunitz, and Slanetz (*9*) reinvestigated two lard distillates and found indications of the presence of vitamin A. These