It is unlikely that the aluminum end of the aluminum–vanadium complex is the catalytically active site since this portion is structurally identical to one end of an alkyl aluminum halide dimer, and these compounds are not low pressure polymerization catalysts. The polymer molecule is believed to grow from the vanadium center by a two-step process[4,5] of coördination of the ethylene with a vacant orbital of the vanadium species followed by a rearrangement to give net addition of the V–R bond across the ethylene double bond. The function of the aluminum alkyl is to reduce the vanadium to the divalent state and alkylate it to form the active species (RVX). By formation of a complex, the aluminum bromide (or $RAlX_2$) dissolves the active species, stabilizes it, and prevents further reduction of the vanadium.

(4) D. B. Ludlum, A. W. Anderson and C. E. Ashby, THIS JOURNAL, **80**, 1380 (1958).

(5) W. L. Carrick, W. T. Reichle, R. W. Kluiber, E. F. Bonner, and J. J. Smith, Paper No. 47, Polymer Division, 133rd Meeting of the American Chemical Society, San Francisco, California.

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EFFECTS OF DIAMINES ON THE PROTOPLAST-INFECTING AGENT DERIVED FROM T2 BACTERIOPHAGE

Sir:

Hershey[1] has reported the presence in T2 bacteriophage of two low molecular weight, ninhydrin-positive components derived biosynthetically from arginine, and associated with the deoxyribonucleic acid (DNA) of the virus in the process of infection of cells of *Escherichia coli*. Ames, *et al.*,[2] have identified these two components as putrescine (tetramethylenediamine) and spermidine (H_2N-$(CH_2)_4NH(CH_2)_3NH_2$). We now wish to report that the probable function of these amines is the preservation of the bacteriophage DNA in an infective conformation. The basis for this hypothesis is found in experiments with the protoplast-infecting agent (π)[3] (Table I): (1) heating at 72.5° destroys π very rapidly; (2) certain preparations of π show marked inactivation with dilution in 0.10 or 0.15 *M* NaCl; (3) repeated freezing and thawing of π renders it much more labile to subsequent heat inactivation.

TABLE I

PROTECTIVE EFFECTS OF CADAVERINE

Retention, % of infectivity after treatment	Treatment: Dilution 64-fold	Heat Treatment 72.5°/5 min.	Heat Treatment 67.5°/1.5 min.	Heat treatment 67.5°/1.5 min. after 10 × freezing-thawing In saline	Heat treatment 67.5°/1.5 min. after 10 × freezing-thawing In 0.01 *M* cadaverine
In 0.15 *M* saline	<2.0	<0.04	6.0	0.19	1.6
Same plus 0.01 *M* cadaverine	100	88	85	12	56

(1) A. D. Hershey, *Virology*, **4**, 237 (1957).

(2) B. Ames, D. T. Dubin and S. M. Rosenthal, *Science*, **127**, 814 (1958).

(3) D. Fraser, H. R. Mahler, A. L. Sing and C. A. Thomas, *Proc. Natl. Acad. Sci.*, **43**, 939 (1957).

Certain polymethylene diamines of the general structure H_2N-$(CH_2)n$-NH_2 as well as spermidine protect π against all of these effects to a remarkable degree; maximum protective action is exerted by cadaverine (n = 5). A reasonable model for the cadaverine dihydrochloride molecule (the species present at *p*H 5.5) leads to an N–N distance of 7.30 Å. The distance between phosphate oxygens in the revised DNA structure proposed by Wilkins[4] is 7.65 Å.

All experiments performed at the temperature indicated, in 0.15 *M* NaCl (plus cadaverine where indicated) at a *p*H of 5.5. The π preparation was diluted 1:20 into the incubation tube and samples were withdrawn at 30-second intervals, and diluted 1:20 into chilled 0.15 *M* NaCl kept at 0°. They were then assayed for infectivity in our standard system.[3]

(4) *Cf.* drawing by J. C. Kendrew, and M. F. Perutz, in *Ann. Rev., Biochem.*, **26**, 340 (1957); also R. Langridge, W. E. Seeds, H. R. Wilson, C. W. Hooper, M. H. F. Wilkins and L. D. Hamilton, *J. Biophys. Biochem. Cytol.*, **3**, 767 (1957).

(5) Supported by Grant No. E-1854 from the Institute of Microbiology and Immunology of the National Institutes of Health.

(6) Contribution No. 867.

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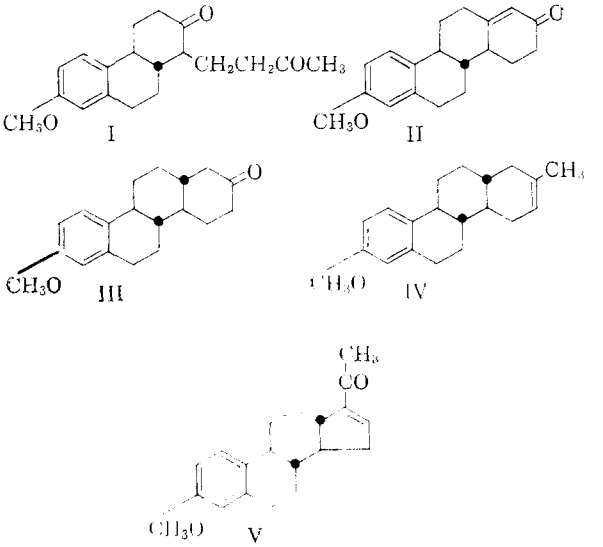
SYNTHESIS OF 18,19-DINOR STEROIDS

Sir:

A practicable route from natural steroids to 18,19-dinor steroids, including the estrone, testosterone, progesterone, and desoxycorticosterone analogs, has been achieved and is reported here.

Boric acid-catalyzed rearrangement of estradiol 3-methyl ether[1] followed by ozonolysis of the resulting olefin produced the diketone I, m.p. 119–120°; $[\alpha]_D$ +98°; (*Anal.* Found: C, 76.14; H,



(1) Personal communication from Dr. D. A. Tyner of these laboratories.