2·5 p.p.m. (excluding those sediments with an extraordinary content of uranium).

YUKIO SUGIMURA
Meteorological Research Institute,
Mabashi, Suginami, Tokyo.
TOSHIKO SUGIMURA
Department of Nuclear Engineering,
Tokai University,
Tomigaya, Shibuya, Tokyo.

[1] Adams, J. A. S., Osmond, J. K., and Rogers, J. J. W., *Chemistry and Physics of the Earth*, 3, edit. by Ahrens, L. H. (Pergamon Press, New York, 1959).
[2] Baranov, V. J., and Kuzmina, R. A., *Geochemistry*, No. 1, 23 (1957).
[3] Urry, D., *Amer. J. Sci.*, **239**, 191 (1941).
[4] Yoe, J. H., Hill, F., and Black, R. A., *Anal. Chem.*, **25**, 1200 (1953).
[5] Tatsumoto, M., and Goldberg, E. D., *Geochim. Cosmochim. Acta*, **17**, 201 (1959).
[6] Holland, H. D., and Kulp, J. L., *Geochim. Cosmochim. Acta*, **5**, 197 (1954).

BIOPHYSICS

Mechanism of the Reaction of Polynucleotides and Hg^{II}

THE reversible reaction of deoxyribonucleic acid (DNA) and Hg^{II} has been known for some nine years[1] during which it has been studied by a wide variety of techniques[1–5]. All the studies concur in demonstrating that the binding is quite strong but can nevertheless be completely reversed by a variety of common chemical reagents which complex Hg^{II}. After reversal the DNA is both structurally and functionally intact despite the large changes in physical properties which accompany and characterize the reaction. Initially thought to be a reaction which occurred primarily with phosphoryl groups[1] it was later convincingly suggested by Thomas[2] that the reaction occurred primarily at the bases. A few years later this observation was confirmed and extended to a greater variety of polydeoxyribonucleotides[3,5] and most recently to the polyribonucleotide of tobacco mosaic virus[6].

The mechanism of the reaction has remained a puzzle, however, in spite of many suggestions. The purpose of this communication, therefore, is to outline briefly a step-function mechanism which can incorporate the known facts and is capable of predicting many as yet unknown experimentally.

In their recent work Yamane and Davidson[5] showed that H^+ is released when Hg^{II} reacts with DNA. They examined the hydrogen ion release as a function of added increments of Hg^{II} and were able to obtain plots of $\Delta H^+/\Delta Hg^{++}$ as a function of r for several kinds of DNA as well as *A–T* polymer, a synthetic polydeoxyribonucleotide. The quantity ΔH^+ is the average release of hydrogen ion when a small quantity ΔHg^{++} is added to a solution of a polynucleotide[II]. The quantity r is the number of moles of Hg^{II} added per mole of nucleotide.

The mechanism assumes that all or nearly all the Hg^{II} added up to $r = 0{\cdot}5$ reacts to form 2 : 1 base—Hg^{II} complexes; that the complexes bridge the double strands of the DNA helix; that Hg^{II}—(thymidine)$_2$ complexes are much more readily formed than any of the other possible 2 : 1 compounds; that a chain shift induced by Hg^{II} occurs such that complementary bases opposite each other in the original unperturbed structure are displaced by an Hg^{II} bridge to the nearest (opposite) neighbour and that as a first approximation the bases in the natural DNA's are distributed as random along the chain. Knowing the formulæ of all the 1 : 1 nucleoside—Hg^{II} complexes[5] it is not hard to make reasonable formulæ for all the 2 : 1 nucleoside complexes (the 2 : 1 adenosine—Hg^{II} complex has been reported[5]) and with these and the assumptions given above to construct step functions to fit the curves of Yamane and Davidson. Fig. 1 shows an example of the fit of such a function to the data for *E. coli* DNA. The curves for calf-thymus and *M. lysodeikticus* DNA's and *A–T* polymer can be similarly constructed. The positions and extents of the plateaux and abrupt drops which are obvious in the curves of Yamane and Davidson find a natural and general explanation in the mechanism. In addition, the mechanism lends itself readily to the more elaborate treatments of 'binding' available[7]. It is already sufficiently successful quantitatively to permit the prediction that the Hg^{II} reaction of polynucleotides can be used in fundamental studies of nucleotide sequence and in determination of the base composition of polynucleotides. These and other ramifications will be discussed at length elsewhere.

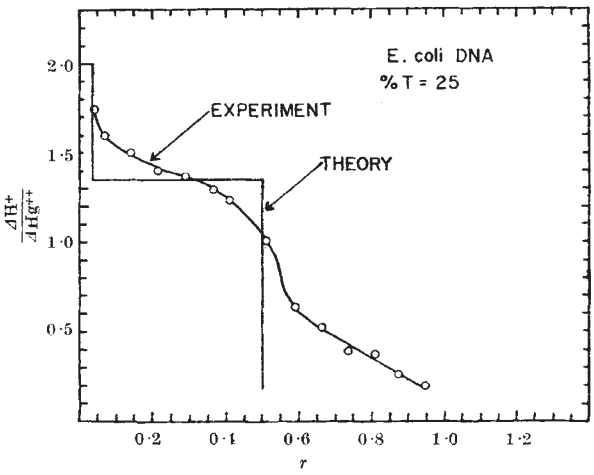

Fig. 1. The fit of a step-function theory to the data of Yamane and Davidson

This investigation was supported in part by a research grant, *A*–4195, from the National Institute of Arthritis and Metabolic Diseases, U.S. Public Health Service, awarded to Dr. Sidney Shulman.

SIDNEY KATZ
Department of Biophysics
University of Buffalo,
School of Medicine, Buffalo, N.Y.

[1] Katz, S., *J. Amer. Chem. Soc.*, **74**, 2238 (1952).
[2] Thomas, C. A., *J. Amer. Chem. Soc.*, **76**, 6032 (1954).
[3] Pour-El, A., thesis, University of California, Berkeley (1960).
[4] Dove, W. F., and Yamane, T., *Biochem. Biophys. Res. Comm.*, 3, 608 (1960).
[5] Yamane, T., and Davidson, N., *J. Amer. Chem. Soc.*, **83**, 2599 (1960).
[6] Katz, S., and Santilli, V., *Biochim. Biophys. Acta* (in the press).
[7] Cf., for example, Klotz, I., in *The Proteins*, edit. by Neurath, H. and Bailey, K., 1, Part B, 790 (Academic Press, New York, 1953).

CHEMISTRY

A Transparent Semiconducting Indicator Electrode

DURING the course of an investigation of the photosensitivity of silver halide precipitates, the need for a transparent, conducting electrode sensitive to halogens became evident. A new practical solution to the problem has been found by the use of thin