less marked inhibitory action. The specificity of the action of thiol inhibitors was confirmed in all cases by reversal of the inhibition with the thiol-reducing agents: glutathione and cysteine. Potassium cyanide, sodium azide, sodium fluoride and malonate had no action on the motility of *Proteus vulgaris*. (3) Substances having a narcotic effect, such as chloral hydrate, barbital, phenobarbital and chloroform, inhibited motility only at high concentrations. In these cases recovery of motility could be obtained by simply washing in buffer or saline. (4) Adenosintriphosphate had a definite stimulating effect on the motility of *Proteus vulgaris*. It was found that in bacteria inhibited with chloral hydrate vibration and translatory movements started within periods of time which were 110 and 74% shorter with ATP than with saline or other organic or inorganic phosphates. The possible role of —SH groups and of ATP in bacterial locomotion is discussed.

Thanks are given to Dr. Luis F. Leloir for providing the phosphate compounds. Thanks are also given to Dr. E. S. Guzman Barron for reading the manuscript.

Received October 22, 1951. P.S.E.B.M., 1951, v78.

Size and Shape of Blood Group *A*-Substance. (19149)

ARTHUR B. PARDEE* AND ROBERT H. BLAKER.† (Introduced by W. M. Stanley.)

From Gates and Crellin Laboratories of Chemistry, California Institute of Technology.

Kekwick has recently presented data on the size and shape of an A-substance preparation from pseudomucinous ovarian cyst fluid(1). He obtained a molecular weight of 260000 and an axial ratio of 60/1 from ultracentrifuge and diffusion measurements. For comparison it seems worthwhile to present briefly data obtained on other preparations of A-substance(2).

Materials. The closely related preparations R18-F10, R19-F1A, and R19-F2A of A-substance from hog gastric mucin were used (3,4).‡ This material is known to be chemically and immunologically inhomogeneous (3,4). The solvent used in all experiments was 0.02 M phosphate buffer at pH 7.1 with sufficient sodium chloride to give an ionic strength of 0.15.

Light scattering. Measurements were made at concentrations between 1.0 and 0.1%. Values of the reciprocal of specific turbidity were plotted against concentration and extrapolated to zero concentration. The molecular weights of R19-F1A and R19-F2A calculated from the values of $(C/\tau)_{C=0}$ were 900,000 and 1,100,000 respectively. All samples were centrifuged for 30 minutes at 25,000 times gravity to remove optical haze. The refractive index increment for 5461 Å was 0.14 (concentration expressed as weight fraction).

Diffusion. Free diffusion measurements at 2 concentrations of R18-F10 were made at 1.3°C in a Neurath cell using a Longsworth scanning optical system. By the height-area method

$$D^{20^\circ}_{H_2O} = 1.12 \pm 0.11 \cdot 10^{-7}\ \text{cm}^2/\text{sec.}$$

and by the method of successive analysis

$$D^{20^\circ}_{H_2O} = 1.03 \pm 0.07 \cdot 10^{-7}\ \text{cm}^2/\text{sec.}$$

for 5 determinations. Pycnometric measurements gave an apparent specific volume of 0.66 ml/g.

* Present address: Virus Laboratory, University of California, Berkeley, Calif.

† Present address, E. I. duPont de Nemours and Company, Box 525, Wilmington, Del.

‡ We are indebted to Doctors Holzman and Niemann for providing this material, and for helpful suggestions.

1. Kekwick, R. A., *Biochem. J.*, 1950, v46, 438.

2. Pardee, A. B., Thesis, California Institute of Technology, 1947.

3. Holzman, G. and Niemann, C., *J. Am. Chem. Soc.*, 1950, v72, 2044.

4. Holzman, G., and Niemann, C., *J. Am. Chem. Soc.*, 1950, v72, 2048.

TABLE I. η_{sp}/Φ of A-Substance.

$\Phi \cdot 10^3$	Average shear gradient of solvent 10200	5400	1000
R19-F1A			
3.91	150	210	300
1.96	130	170	260
0.78	—	140	240
R19-F2A			
3.31	190	250	400
1.65	170	220	330
0.66	170	220	290

Viscosity. The values of specific viscosity, η_{sp}, divided by volume fraction of solute, Φ, at different rates of shear are given in Table I. Measurements were made in an Ostwald-Fenske viscometer at 25°C.

Osmotic pressure. Four measurements at one and 2% concentration gave the molecular weight of R18-F10 as 220,000 ± 30,000, uncorrected for deviations from ideal behavior.

Discussion. If the molecules are assumed to be anhydrous rod-like ellipsoids, the viscosity data lead to a value of 60/1 for the axial ratio. This value, together with diffusion and density data, gives an average value of 1,000,000 for the molecular weight.

Table I shows the marked dependence of the value of η_{sp}/Φ on shear gradient and on concentration. This behavior is more like that of a rod-like particle than a random coil.§

The molecular weights from light scattering data agree fairly well with that from viscosity and diffusion. Osmotic pressure data lead to a much lower value. Since the latter method gives a number-average molecular weight and the light-scattering method gives a weight-average molecular weight, the results are compatible with the assumption that the material is heterogeneous. The data do not permit one to decide whether a few per cent of larger or smaller molecules account for the results, or the preparations contain a broad distribution of sizes with significant numbers of molecules with molecular weights less than 200,000 and greater than one million.

It may be *concluded* that A-substance from hog gastric mucin, like A-substance from pseudomucinous ovarian cyst fluid, is a very large molecule and probably is highly asymmetric.

§ We are indebted to Dr. Hans Kuhn for interpreting these data.

Received October 15, 1951. P.S.E.B.M., 1951, v78.

Experimental Bacterial Endocarditis in Altitude Rats II. Shortening Acclimatization Period. (19150)

BENJAMIN HIGHMAN AND PAUL D. ALTLAND. (Introduced by W. F. von Oettingen.)

From the National Institute of Arthritis and Metabolic Diseases, National Institutes of Health, Public Health Service, Federal Security Agency, Bethesda, Md.

The mortality rate of subacute bacterial endocarditis, despite antibiotic therapy, averages about 30%(1). Lack of a suitable experimental animal has handicapped hitherto the search for more effective treatment. The screening of therapeutic methods calls for a readily available small laboratory test animal which is highly susceptible to experimentally induced bacterial endocarditis. Since the therapeutic response in man often varies considerably with the specific infectious agent, the experimental animal should be susceptible to various strains obtained from human cases of bacterial endocarditis.

It was shown previously that exposure of rats 4 hours daily for 3 to 6 months in a low pressure chamber to simulated altitudes of 25,000 feet (7620 meters, bar. p. 282 mm Hg) damages the cardiac valves(2), and that ex-

1. Henry, L., *Postgrad. Med.*, 1950, v7, 366.

2. Highman, B., and Altland, P. D., *Arch. Path.*, 1949, v48, 503.