Table 1. EFFECT OF CLAM LIVER EXTRACT ON *L*1210 IN DBF_1 MICE WHEN TREATMENT WAS STARTED ON DAY 1

Group	Dose (mg/kg) Daily	Dose (mg/kg) Total	No. of mice	MST (days)	% Increase of MST over controls
1	300	3,000	8	9·5	−5
2	250	2,500	8	14·0	40
3	200	2,000	8	13·0	30
4	150	1,500	8	11·5	15
5	100	1,000	8	12·0	20
6	50	500	8	10·5	5
7 (Control)	0	0	20	10·0	0

MST, Mean survival time, calculated according to the formula of the Cancer Chemotherapy National Service Center[8]. This table shows one typical test chosen from thirty positive antitumour tests for more than ten preparations of clam liver extracts, using thirty to sixty mice for each test (five to eight mice for each test dose). The results were all comparable, with an increase of 30–70 per cent of MST of treated mice over controls. The optimal dose varied from 70 to 250 mg/kg/day for 3–10 days. In some experiments treatment was delayed to 5 days after tumour implantation and MST of treated mice was similarly increased. MST in all experiments was calculated according to the formula stated here.

trols. This may be considered as optimal dose for the particular preparation.

Ten additional preparations of clam liver extracts were made and similarly assayed, except that the schedule of treatment varied in each test. Every preparation showed definite antileukaemic activity. The experimental results obtained were comparable with those described already, indicating the consistency of activity exerted by clam liver extract. Extracts prepared from the whole clam, containing liver, also showed some activity in the same test system, in experiments not presented here. Potency of the latter preparations was not as high and the activity was not as consistent as those obtained with extracts made from the liver tissue alone. No special effort was made to determine the relative distribution of this activity in all organs of the clam other than livers. Preliminary studies, however, revealed that certain other parts of the clam body also contained the active principle. The liver was chosen for this work because it could be dissected out easily and probably contained the highest amount of active material. The clam liver extract is not being suggested as an antileukaemic drug in man because of its toxicity and because its activity cannot match that of the currently available drugs, such as methotrexate. In fact, methotrexate was used for positive control in our experiments and it usually increased the MST by 110 per cent or more when the optimal dose, 3 mg/kg/day, was given subcutaneously to the leukaemic mice from day 1 to day 7. The observation of antileukaemic activity in clam liver represents an interesting biological phenomenon, and further study on the origin and chemical nature of the active principle might lead to useful implications.

We acknowledge the cooperation of the following participants in the performance of certain aspects of the tests of clam extracts: Drs A. Goldin and J. M. Venditti (National Cancer Institute), I. Kline (Microbiological Associates, Bethesda, Maryland), E. J. Schantz (Chemical Corps, Fort Detrick, Frederick, Maryland), and Mr S. R. Humphreys (National Cancer Institute). We also thank Drs C. W. Hiatt (Division of Biologics Standards) and H. A. Sober (National Cancer Institute) for their advice.

C. P. Li
B. Prescott
E. C. Martino

National Institutes of Health,
Bethesda, Maryland.

O. C. Liu

Northeast Marine Laboratory,
Narragansett, Rhode Island.

Received June 21; revised July 22, 1968.

1 Schmeer, M. R., *Science*, **144**, 413 (1964).
2 Hegyeli, A., *Science*, **146**, 77 (1964).
3 Li, C. P., Prescott, B., Jahnes, W. G., and Martino, E. C., *Trans. NY Acad. Sci.*, Series II, **24**, 504 (1962).
4 Li, C. P., Prescott, B., Eddy, B., Caldes, G., Green, W. R., Martino, E. C., and Young, A. M., *Ann. NY Acad. Sci.*, **130**, Art. 1, 874 (1965).
5 Judge, J. K., *Proc. Soc. Exp. Biol. and Med.*, **123**, 299 (1966).
6 Liu, O. C., and Cipolla, R. J., *Bact. Proc.*, **164**, 162 (1967).
7 Goldin, A., Venditti, J. M., Humphreys, S. R., and Mantel, N., *J. Nat. Cancer Inst.*, **21**, 495 (1958).
8 Prescott, B., and Caldes, G., *Fed. Proc.*, **26**, 314 (abstract 336) (1967).

Plasma Spermine Oxidase in relation to Fermentation in Hippopotamus Stomach

The communication by Thurston, Noirot-Timothée and Arman[1] is of interest to the enzymologist. The authors relate the occurrence of ciliate protozoa in the stomach of *Hippopotamus amphibius*, a non-ruminant ungulate, to the fact that in this species, as in the ruminants, fermentation takes place in the stomach.

Some time ago it was found that the spermine oxidase of blood plasma was essentially restricted to ruminants; all the members of the two sub-orders Ruminantia and Tylopoda that were tested contained this enzyme. It is known that many non-ruminants contain a similar plasma oxidase without activity on spermine and related polyamines. It was suggested that the ability to oxidize polyamines was connected with the type of fermentation peculiar to the digestive tract of these animals.

A few occurrences of spermine oxidases in the plasma of non-ruminants, however, were noted. The first of these was the hippopotamus, where a plasma spermine oxidase was found. This finding, which is of particular interest in relation to the observations by Thurston *et al.*, was discussed in the light of similarities between the digestive tracts of ruminants and the hippopotamus.

Another interesting occurrence of spermine oxidase was in the blood plasma of two members of the order Hyracoidea, *Procavia capensis* and *Dendrohyrax dorsalis*. These animals are less closely related to the ruminants than is the hippopotamus. The Hyracoidea, however, have a digestive tract which also differs markedly from the more usual mammalian pattern; it is characterized by the presence of a so-called "accessory caecum". According to Grassé[2], this compartment contains some unusual micro-organisms.

Since the distribution of spermine oxidase was first studied[3,4], much has been learnt of the ability of mammalian tissues to synthesize their own polyamines; this has added fresh support to the idea that spermine oxidase is connected not so much with the presence of endogenous polyamines but with the fermentations that occur in the digestive tract of those animals in which this plasma enzyme is present.

H. Blaschko

Department of Pharmacology,
University of Oxford.

Received July 9, 1968.

1 Thurston, J. P., Noirot-Timothée, C., and Arman, P., *Nature*, **218**, 882 (1968).
2 Grassé, P.-P., in *Traité de Zoologie*, Tome XVII, 878 (edit. by Grassé, P.-P.) (Masson, Paris, 1955).
3 Blaschko, H., *Adv. Comp. Physiol. Biochem.*, **1**, 67 (1962).
4 Blaschko, H., and Bonney, R., *Proc. Roy. Soc.*, B, **156**, 268 (1962).

New Human Haemoglobin Variant from Southern Arabia: G-Audhali (α23(B4) Glutamic Acid→Valine) and the Variability of B4 in Human Haemoglobin

In 1966–67 a survey for electrophoretically abnormal haemoglobin variants was carried out in southern Arabia. Samples of venous blood were collected from 2,130 Arabs and examined for sickling and signs of thalassaemia, and the haemoglobins were screened by electrophoresis on cellulose acetate[1]. The subjects included 234 members of the Audhali tribe in whom three sickle cell trait carriers, five persons with β thalassaemia minor, and two with a similar haemoglobin variant were discovered; these two are the subject of this report. The variant moved