U-tube in which a column of 0·5 per cent hyaluronic acid solution could be moved by gentle suction and blowing, the potentials between silver – silver chloride electrodes dipping through the two surfaces were led to the symmetrical d.c. input of a cathode ray oscillograph (*OSG* 41, Radiometer, Copenhagen; input impedance 1 MΩ).

In this way potentials of 6–10 mV. were obtained, positive at the advancing surface and persisting until the liquid is allowed to return towards its original position. In special cases much higher potentials (20–25 mV.) were found: namely, at the first displacement after filling with fresh solution, and when after blowing out the bulk of the solution we filled the tube with water, which slowly dissolved the adsorbed film. With pure water, and also with a 10 per cent gum arabic solution, potential shifts during the same manipulations were equal to or less than the noise-level of 1–2 mV.

A more detailed study of the potentials is planned, and we also hope in a later publication to give a detailed discussion of the significance of these potentials in connexion with the function of the inner ear.

We are indebted to the head of this Institute, Prof. J. A. Christiansen, for his interest in this work.

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[1] Jensen, C. E., and Koefoed, J., *J. Coll. Sci.*, [9, 460 (1954)].
[2] Scott Blair, G. W., *et al.*, *Biochem. J.*, **35**, 1039 (1941).
[3] Vilstrup, Th., and Jensen, C. E., *Ann. Otology, Rhinology and Laryngology*, **63**, 151 (1954).
[4] Wever, E. G., and Bray, C. W., *Proc. U.S. Nat. Acad. Sci.*, **16**, 344 (1930).

Protective Effect of *d,l*-α-Octadecylglycerol-ether in Mice given Total Body X-Irradiation

Sandler[1] claimed that the protective factor against benzene poisoning found in yellow bone marrow is batyl alcohol or one of its esters. Since batyl alcohol is found in those organs which are said to contain a humoral factor that protects animals against the acute phase of irradiation injury[2], the following experiments were carried out. Sixty adult white male mice of an inbred strain (16 years) were irradiated with a therapeutic X-ray machine, 165 kV., 15 m.amp., filters 0·5 mm. copper + 1 mm. aluminium, target distance 60 cm., irradiation time 25 min., total dose 750 r. (air). Two hours after the end of the irradiation, thirty animals chosen at random were given 0·1 ml. of peanut oil subcutaneously, the others the same volume of peanut oil containing 2·5 mgm. *dl*-batyl alcohol per ml. These injections were repeated every second day until 1·75 mgm. of *dl*-batyl alcohol or a corresponding amount of the solvent had been administered to the animals. The 30-day lethality for the animals treated with batyl alcohol was seventeen out of thirty and for the controls twenty-six out of thirty. The difference is statistically significant ($P < 0{\cdot}01$).

I have tried to find the optimal dosages for the synthetic alcohol and then for the naturally occurring alkoxyglycerol esters. From these experiments it can be concluded that in certain circumstances both these agents have a beneficial therapeutic effect on irradiation injury in mice; overdosage, however, increases the lethality. Further studies are in progress.

Simultaneously, but independently, Brohult *et al.* [following communication] have studied the effect of alkoxyglycerols in the treatment of leukopænia caused by irradiation.

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[1] Sandler, O. E., *Acta Medica Scand.*, Supp. 225 (1949).
[2] Lorenz, E., and Congdon, Ch. C., "Annual Review of Medicine", 5, 323 (1954).

Alkoxyglycerols in the Treatment of Leukopænia caused by Irradiation

During irradiation therapy the blood-forming tissues are subjected to a great strain. At first this becomes noticeable in the form of a decreased white-cell count. This leucopænia sometimes necessitates an interruption of the irradiation therapy and consequently the time of treatment of the patient is prolonged.

Since the autumn of 1953, we have administered *per os* α-alkoxyglycerol preparations to some patients treated with irradiation. The alkoxyglycerols and particularly their esters are present in the lipids of several animal organs. One of the alkoxyglycerols, namely, batyl alcohol, is found in, for example, bone marrow fat[1], it forms part of the 'non-saponifiable' spleen lipids[2], and in the red cells[3]. It is also found in the liver lipids, and particularly in the liver lipids of sharks. Its presence in the red cells and in blood-forming organs is noteworthy.

The idea of administering extracts of erythropoietic tissues in disorders in the erythropoietic process is not new. Thus Marberg and Wiles[4] reported that the non-saponifiable portion of yellow bone marrow fat from cattle was effective in the treatment of agranulocytosis and leukopænia. Later Sandler[5] studied the erythropoietic effect of yellow bone-marrow extracts as well as batyl alcohol. Sandler states that a definite response in the reticulocyte count was obtained when batyl alcohol was administered orally to normal subjects.

We examined the effect in 1952 of giving the non-saponifiable portion of bone fats *per os* to some cases of leukæmia in children. We then continued with other preparations containing alkoxyglycerols and their esters in the form of concentrates. These concentrates had a higher potency than the bone-marrow preparations. The observations from some of these cases form the background of the experiments reported here.

To patients suffering from irradiation leukopænia, alkoxyglycerol esters were administered *per os* while the irradiation was continued. So far thirty-six cases have been studied. Of these, twenty-five responded to the therapy by an immediate increase in the white-cell count. In nine cases there was no further decrease in white cells after starting therapy. Only two cases showed a continued decrease in leucocytes.

A striking effect is illustrated by the following observations during the treatment of a nurse who had been occupied in radium therapy for some years. She had for more than a year a white-cell count of about 2,000 and was treated for five days with an alkoxyglycerol ester concentrate *per os* as the only therapy. Already after four days a white-cell count

of 3,600 was reached. After withdrawal of medication, this level was maintained for five months with only one additional four-day treatment. A third period of four days of therapy followed after five months and resulted in a white-cell count of 4,200. Treatment for a few days obviously maintained the white-cell count on a normal level for a long period.

We thus conclude that treatment *per os* with alkoxyglycerols as well as their esters is a promising therapy against leukopænia caused by irradiation. The alkoxyglycerols might also give a more general protection of the blood-forming tissues against irradiation damages. A more detailed study of this subject, as well as of other effects of the alkoxyglycerols, will be published elsewhere.

Simultaneously, but independently, Edlund has studied the protective action of batyl alcohol on irradiated mice [see preceding communication].

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[1] Holmes, H. N., Corbet, R. E., Geiger, W. B., Kornblum, N., and Alexander, W., *J. Amer. Chem. Soc.*, **63**, 2607 (1941).
[2] Prelog, V., Ruzicka, L., and Stein, P., *Helv. Chim. Acta*, **26**, 2222 (1943).
[3] Holmberg, J. (unpublished, 1952).
[4] Marberg, C. M., and Wiles, O. H., *Arch. Int. Med.*, **61**, 408 (1938).
[5] Sandler, O. E., *Acta Medica Scand.*, Supp. 225 (1949).

Exchange of ^{14}C-Glucose-1-phosphate with Uridine-diphosphate-glucose by the Galacto-Waldenase System

A TWO-STEP reaction, as represented by reactions 1 and 2, has been proposed[1] for the enzymatic transformation of galactose-1-phosphate into glucose-1-phosphate :

$$\text{Gal-1-P} + \text{UDPG} \rightleftharpoons \text{G-1-P} + \text{UDPGal} \quad (1)$$

$$\text{UDPGal} \rightleftharpoons \text{UDPG} \quad (2)$$

Reaction 2 has been experimentally demonstrated[1]. Kalckar *et al.*[2] have recently reported as evidence for the occurrence of reaction 1 the formation of 1 mol. of glucose-1-phosphate per mol. of uridine-diphosphate-glucose and of galactose-1-phosphate consumed, when these two compounds are incubated with diluted *Saccharomyces fragilis* extract.

If the proposed mechanism is correct, incorporation of carbon-14 glucose into the uridine-diphosphate-glucose should occur when this compound and ^{14}C-glucose-1-phosphate are incubated with *S. fragilis* extract. The experiments reported here have shown this to be the case.

Since phosphoglucomutase is present in the crude *S. fragilis* extracts, ^{14}C-glucose-1-phosphate could be replaced by ^{14}C-glucose-6-phosphate. This was prepared by incubation of glucose labelled uniformly with carbon-14 plus adenosine triphosphate with partially purified yeast hexokinase. A preparation purified by the method of Berger *et al.*[3] up to step 4 was used. ^{14}C-glucose-6-phosphate was precipitated as barium salt, which was then dissolved and re-precipitated with barium and alcohol. A preparation devoid of reducing power and inorganic phosphate was obtained.

^{14}C-glucose-6-phosphate and uridine-diphosphate-glucose were incubated with dialysed *S. fragilis* extract under the conditions specified in Table 1. The reaction was stopped by adding to the incubated mixture four volumes of alcohol and 0·02 ml. of *M* acetic acid solution. The protein precipitate was centrifuged and washed twice with 70 per cent alcohol. Supernatants and washings were mixed and the resulting solutions evaporated *in vacuo* to dryness. The residues were taken up in distilled water, deposited on a sheet of Whatman No. 1 filter paper, and chromatographed with the acid ethanol–ammonium acetate solvent[4]. Areas on the paper carrying the equilibrium mixture of uridine-diphosphate-glucose (75 per cent) and uridine-diphosphate-galactose (25 per cent) were located by ultra-violet light and eluted with distilled water. The amount of this equilibrium mixture in the samples was determined by measuring the absorption of an aliquot at 260 mμ in a Beckman spectrophotometer. The carbon-14-labelled equilibrium mixture was determined by measuring the radioactivity of an aliquot evaporated on an aluminium disk, with a thin mica end-window Geiger–Müller tube and a 'Tracerlab' scaler. As is shown in Table 1, after 30 min. of incubation, the radioactivity of glucose-6-phosphate was equilibrated with that of the above equilibrium mixture. The small amount of radioactivity found in the latter incubated without uridine-diphosphate-glucose must be due to the presence of small amounts of this compound in the dialysed extract.

When in the experiment described in Table 1, ^{14}C-glucose-6-phosphate was replaced by ^{14}C-glucose, no radioactivity was incorporated into the uridine-diphosphate-glucose.

Kalckar *et al.*[5] demonstrated the occurrence in *S. fragilis* extracts of reaction 3, catalysed by a specific pyrophosphorylase, which has been named 'uridyl transferase'[2] :

$$\text{UDPG} + \text{PP} \rightleftharpoons \text{G-1-P} + \text{UTP}. \quad (3)$$

The incorporation of ^{14}C-glucose into uridine-diphosphate-glucose might alternatively be explained by the reversal of reaction (3), were it not for the fact that in the absence of uridine-tri- or di-phosphate and adenosine triphosphate[6], a condition fulfilled by the dialysed extract, this mechanism is not operating. Thus our results are in favour of the mechanism represented by reactions 1 and 2.

Table 1. INCUBATION OF ^{14}C-GLUCOSE-6-PHOSPHATE AND URIDINE-DIPHOSPHATE-GLUCOSE WITH *S. fragilis* EXTRACT

Incubation at 37° C. of 0·33 μ*M* of ^{14}C-glucose-6-phosphate of specific activity 5,910 counts/min./μ*M*, 0·01 μ*M* of glucose-1,6-diphosphate, 0·3 μ*M* of uridine-diphosphate-glucose and 2 μ*M* of magnesium ions with 0·01 ml. of dialysed *S. fragilis* extract

Mixture	Incubation time (min.)	Spec. activity UDPG glucose counts/min./μ*M*	Spec. activity UDPG glucose (exp.) / Spec. activity glucose-6-phosphate equilibrated with UDPG (calc.)
Without uridine-diphosphate-glucose*	30	290	0·09
Complete	30	2,910	0·98
Complete	60	2,400	0·81

* UDPG added after the enzyme was inactivated