proliferating cells one or more mechanisms may exist which result in succinic dehydrogenase and also alpha-glycerophosphate dehydrogenase becoming dissociated from CoQ_{10} and the cytochrome electron transport chain.

The nature of the alteration of quinone-dehydrogenase relationship which occurs in the regenerating liver and hepatoma appear to differ. In considering the pattern of response of the reductases of regenerating liver to the 2 quinones, account should be taken of the fact that regenerating liver is a sharply self-limited proliferative process occurring in an adult tissue. Accordingly, an attractive hypothesis for explaining the effects of the 2 quinones on this tissue is that the proliferative mechanism is related to a reversible dissociation of the 2 dehydrogenases from the electron transport system by virtue of some effect on CoQ_{10}. Under these conditions it might be more difficult for CoQ_{10} added *in vitro* to couple with the dehydrogenase than it would be for an unnatural quinone such as menadione. In the hepatoma this type of postulated reversible mechanism would presumably be lacking. The pronounced enhancing effect of CoQ_{10} on the 2 reductases of the hepatoma suggest that in this tissue there simply is a lack of available quinone which is most efficiently supplied *in vitro* by addition of the naturally occurring quinone.

Conclusion. Quantitative histochemical studies of sections of normal liver, regenerating liver and Novikoff hepatoma have shown that the succinate-INT and alpha-glycerophosphate-INT reductase systems of these tissues are not saturated with respect to quinone. Compared to normal liver, degree of unsaturation is considerably greater in regenerating liver and hepatoma and largely accounts for those low reductase activities which are observed in these 2 tissues. Response of sections of regenerating liver and hepatoma to CoQ_{10} and menadione differs. CoQ_{10} is very effective in hepatoma. In regenerating liver CoQ_{10} is relatively ineffective whereas enhancement of reductase activity brought about by menadione is profound.

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Dietary Fats and Effects of Internal Radiation by P^{32}.* (25849)

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Several groups of workers reported that addition of corn oil, cottonseed oil, or methyl linoleate to a fat-free diet significantly decreased mortality of mice(1) or rats(2-6) subjected to total body irradiation. On the other hand, our previous data indicated that mice injected with single midlethal dose of P^{32} exhibited greater susceptibility to the isotope when fat content of diet was raised from 5% to 30% level(7). We have now compared effects of P^{32} on mice fed a fat-free diet with those observed in mice fed diets with high content of either a saturated fat (coconut oil), or an unsaturated fat (corn oil). Mortality was lowest in groups on fat-free diet. However, mice fed corn oil showed a better survival than those on coconut oil diet.

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† Technical assistance was given by C. Downs.

TABLE I. Composition of Experimental Diets (Values in g/100 g of Diet).

	Diet A	Diet B	Diet C
Casein	20	20	20
Dextrin	36	21	21
Sucrose	36	21	21
Hydrogenated coconut oil			30
Corn oil		30	

In addition, all diets contained: Salt mixture (U.S.P. XIV),* 4 g; vitamin diet fortification mixture,* 2 g; cellulose ("Alphacel"*), 2 g.

* Nutritional Biochemicals Corp., Cleveland, O.

The beneficial role of EFA‡ became more clearly apparent in experiments in which fat-free diets, supplemented with small amounts of coconut oil, corn oil, or linoleic acid, were used, and mice maintained on diets for 2 to 4 weeks before injection of P^{32}.

Methods. In each experiment, 120 to 160 male albino mice (Rockland Farm "all-purpose" strain) with average initial body weight of 20 g were distributed in groups of 8 or 9, and housed in metallic cages with raised screen floors. In each of Exp. 1 to 8, groups were maintained on fat-free diet (Diet A), or on a diet containing corn oil (Diet B), or coconut oil (Diet C) (Table I). In Exp. 9 to 11, all mice received fat-free diet plus one of following supplements: coconut oil, 3% (Diet A-1), corn oil, 3% (Diet A-2), or linoleic acid, 1.5% (Diet A-3). These supplements were added at the expense of dextrin. Animals were maintained on experimental diets for 3 to 15 days (Exp. 1-8), or 17 to 28 days (Exp. 9-11), then most mice were injected intraperitoneally with 0.2-0.3 ml of Ringer solution of phosphate containing P^{32} and continued on same diets for 6 more weeks. Amounts of P^{32} injected/g of mouse were constant in each experiment, but varied between 4.15 and 5 μc/g in different experiments. Control groups, maintained on experimental diets for same periods, were injected with Ringer solution only.

Results. As in previous investigations(7-10), the following criteria were used as indications of injurious effects of the isotope: a) time of 50% deaths; b) and c) % of survivors at 21st and 42nd day after injection; and d) average survival time, a 42-day survival being assigned to mice still alive when experiments were discontinued. In each experiment, data obtained on groups receiving P^{32} have been corrected for mortality of control groups maintained on same diet, but not injected with P^{32}. In most cases significance of the difference observed between weighted averages was appraised statistically by applying the Chi^2 method to numbers of survivors and the t test(11) to survival times.

It is apparent (Tables II and III) that mice fed fat-free Diet A survived in greater numbers and for longer times than those fed Diets B and C. These results agree with our previous experiments(7) with diets containing a definite proportion of highly unsaturated fat (cod-liver oil) and varying amounts of fat with low iodine number ("Crisco").

On the other hand, the present results show

TABLE II. Survival of Mice Injected with P^{32} and Maintained on a Fat-Free Diet (Diet A), or on High-Fat Diets (Diets B and C).

	Diet A (fat-free)	Diet B (corn oil, 30%)	Diet C (coconut oil, 30%)
No. of mice inj. with P^{32}	216	326	348
Avg food consumption/mouse/day, g	3.1	3.3	2.9
" change in body wt (42 days),* g	+.50	−1.09	−1.26
Time of 50% deaths, days	42	42	19
Survivors at 21 day, %	81	58	45
Survivors at 42 ", %	76	52	39
Avg survival time, days†	36 ± .8	33 ± .7	28 ± .7

Values are avg of 8 experiments, and adjusted on basis of values obtained from control groups not inj. with P^{32}. Mice were maintained on experimental diets for 3 to 15 days (avg, 7.8 days) before inj. of P^{32}. Doses of P^{32} inj. varied between 4.15 and 5 μc/g (avg, 4.34 μc/g).

* Survivors only.

† Values preceded by ± are stand. errors of means.

‡ EFA = Essential fatty acids.

TABLE III. Statistical Comparison of Survival of Mice Injected with P^{32} and Maintained on a Fat-Free Diet (Diet A), or on Diets Containing Corn Oil, 30% (Diet B), or Hydrogenated Coconut Oil, 30% (Diet C).

Diets compared	No. of mice inj. with P^{32}	No. of survivors 21 days Chi²	P*	42 days Chi²	P*	Avg survival time t†	P*
A *vs* C	542	83	<.01	40	<.01	7.6	<.01
A *vs* B	564	28	"	13	"	2.5	<.02
B *vs* C	674	10	"	15	"	5.2	<.01

* Probability for a chance occurrence. † *t*, according to Fisher(11).

that the diet containing a high % of corn oil gave significantly better survival than the diet containing hydrogenated coconut oil. There were no marked differences in food consumption and body weight change, nor were other symptoms of EFA deficiency demonstrable.

The beneficial effects of EFA are further illustrated by results of Exp. 9-11 (Tables IV and V), in which small amounts of coconut oil, or corn oil, or linoleic acid were added to fat-free Diet A. In addition, prior to injection of the isotope, mice were maintained on diets for longer periods (2 to 4 weeks). Even under these conditions, typical signs of EFA deficiency were not seen. However, mice injected with P^{32} and maintained on EFA-free diet died sooner and in a larger proportion than those receiving small amounts of corn oil or linoleic acid. Except for the % of survivors at 42nd day, no significant differences were found in survival of animals receiving either corn oil or linoleic acid.

In conclusion, it appears that there is no actual discrepancy between our previous observation of higher mortality in mice injected with P^{32} and fed high-fat diets, and experiments of other investigators showing that addition of fats rich in EFA to a fat-free diet gives a significant protection against total body X-irradiation. Presumably suscepti-

TABLE IV. Survival of Mice Injected with P^{32} and Maintained on Diet A, Supplemented with Hydrogenated Coconut Oil, 3% (Diet A-1), Corn Oil, 3% (Diet A-2), or Linoleic Acid, 1.5% (Diet A-3).

	Diet A-1 (coconut oil, 3%)	Diet A-2 (corn oil, 3%)	Diet A-3 (linoleic acid, 1.5%)
No. of mice inj. with P^{32}	106	92	91
Avg food consumption/mouse/day, g	1.5	2.8	2.2
" change in body wt (42 days),* g	−.95	−.64	−.90
Time of 50% deaths, days	11	14	16
Survivors at 21 day, %	13	40	41
Survivors at 42 " , %	10	40	22
Avg survival time, days†	15.4 ± .9	25.3 ± .9	23.1 ± 1.2

Values are avg of 3 experiments, and adjusted on basis of values obtained from control groups, not inj. with P^{32}. Before inj. of P^{32}, mice were maintained on experimental diets 17 to 28 days (avg, 24 days). Doses of P^{32} inj. varied from 4.5 to 4.75 μc/g (avg, 4.63 μc/g).

* Survivors only.

† Values preceded by ± are stand. errors of means.

TABLE V. Statistical Comparison of Survival of Mice Injected with P^{32} and Maintained on Diet A, Supplemented with Hydrogenated Coconut Oil, 3% (Diet A-1), Corn Oil, 3% (Diet A-2), or Linoleic Acid, 1.5% (Diet A-3).

Diets compared	No. of mice inj. with P^{32}	No. of survivors 21 days Chi²	P*	42 days Chi²	P*	Avg survival time t†	P*
A-1 *vs* A-2	198	18	<.01	25	<.01	7.5	<.01
A-1 *vs* A-3	197	20	"	6	<.05	5.2	"
A-2 *vs* A-3	183	1	>.05	6	"	1.4	>.05

* Probability for a chance occurrence. † *t*, according to Fisher(11).

bility of animals toward radiation damage is affected both by level of dietary fat and its content in EFA. As long as a severe deficiency of EFA is not fully developed, mice injected with P^{32} and fed a fat-free diet exhibit better survival than mice fed diets containing high levels of fats, saturated or unsaturated. At present, this adverse effect of fat-rich diets is difficult to explain. It is conceivable that radiation damage may be more severe (or less easily reversible) in animals whose tissues are being progressively depleted of EFA.

Summary. Mice were maintained on various experimental diets and injected with single dose of radioactive phosphate (4-5 μc/g). Higher % of survivors and longer survival time were observed in animals on fat-free diet as compared with those fed diets containing 30% corn oil, or 30% hydrogenated coconut oil. However, with these high-fat diets, as well as with diets containing only minimal amounts of fats, a better survival was demonstrable when highly unsaturated fatty acids were present. It appears that, provided that definite amounts of these fatty acids are included, a low-fat diet should be beneficial in alleviating effects of internal radiation by P^{32}.

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Pineal-Like Effects of Central Nervous System Tissue Extracts.* (25850)

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Ranzenhofer *et al.*(1) showed that chicken spinal cord contains something that retards gonadal and comb growth. Retardation of gonadal growth is one of the properties of certain pineal-tissue extracts(2,3). Another effect of such pineal extracts is to elevate blood glutathione and eosinophil counts in schizophrenic patients(2,4). It was therefore decided to study effects of steer-brain extracts on these measurements.

Material and methods. Patients used were all schizophrenic and had been hospitalized for at least a decade. Measurements of blood glutathione level, and of eosinophil count were made as previously described(4). Extracts used were as follows: (a) in 4 patients, extracts of steer-brain "septal" tissue† made by Heath's modification(5) of technic for making pineal extract reported elsewhere(4); (b) in 2 patients extracts of whole steer brain (excluding the pineal)‡ made according to method previously described for pineal extract(4).

Observations. In 4 patients given "septal" extract the amount of extract given daily was derived from 42.5, 85 or 170 g of tissue/day. Dose of extract equivalent to 42.5 g/day caused no significant changes (Case B; Case K); dose of extract equivalent to 85 g of septal tissue/day caused changes in blood gluta-

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