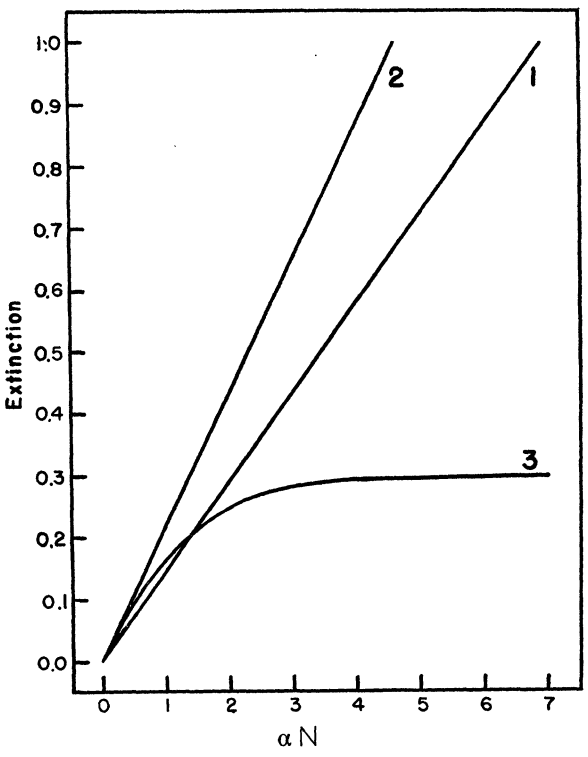

FIG. 1.

E for random orientation in three dimensions. If similar calculations are made for samples in which only a part of the absorbing molecules are fully oriented, one obtains curves lying between Curves 1 and 3 (Fig. 1). These considerations lead us to the conclusion that the Beer-Lambert law must be applied with caution to groups of optically anisotropic molecules which may be more or less oriented.

As previously noted, there is evidence for some degree of orientation in practically all cytological structures other than liquid vacuoles (*5*, *13*). Further, most biologically important molecules are optically anisotropic. Hence the assumption that the concentration of such an absorbing substance in a cell structure can be calculated from the ratio of its extinction value to the extinction of a given number of molecules of the substance in solution is not valid. Furthermore, unless the orientation of the optical axes in two cytological structures is identical, the assumption that the ratio of their extinctions per unit thickness is equal to the ratio of their content of such absorbing material is also invalid. Thus, in cytological absorption measurements made with unpolarized light, variations in extinction values may arise from differences in the degree of orientation rather than from differences in content of any specific substance. It seems clear that the entire problem of interpreting intracellular extinction measurements needs to be reexamined with the realization that one is dealing not with true solutions but with oriented aggregates of molecules.

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Opalescence of Serum after Total Body X-Irradiation as a Prognostic Sign of Death[1]

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During an investigation of the clotting reaction of blood after irradiation with 200-kv X-rays, the author noted the appearance of a marked opalescence in the serum and plasma of rabbits, which subsequently died a few days after exposure to a single lethal dose of total body irradiation. This opalescence appeared within 24 hr following the exposure to radiation. In all cases, it disappeared completely 72 hr after exposure. A review of the literature has failed to reveal any mention of this phenomenon.

Rabbits of the New Zealand white strain were given over the total body single doses of 200 kv X-irradiation, calibrated in air by a Victoreen ionization chamber. Dosage ranged from 200 to 1000 roentgens (r). Blood samples were obtained by cardiac puncture before radiation and at various intervals after radiation (up to 30 days). Serum was obtained from the clotted blood and plasma was obtained by centrifugation of either citrated or oxalated blood. In all cases the opalescence, when present, was noted in both serum and plasma.

The opalescence was noticeable as a pearly white tint homogeneously distributed throughout the sample. Various degrees of intensity have occurred and can be classified as marked, moderate, and slight, as shown in Fig. 1. All animals showing marked opalescence died as a

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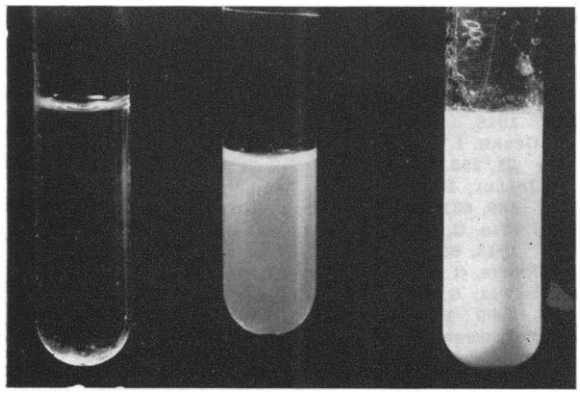

FIG. 1. Tube at left shows clear serum as found before irradiation of rabbit. Center tube shows moderately opalescent serum (rabbit No. 16, 24 hr after irradiation; animal sacrificed 34 days after irradiation). Tube at right shows markedly opalescent serum (rabbit No. 15, 24 hr after irradiation; died a few hours later).

result of radiation within 5 days following exposure. Animals having no opalescence or opalescence to a lesser degree usually survived the radiation for at least 30 days, unless death occurred from other causes.

If opalescence occurred it was prominent 24 hr after radiation, and completely disappeared 3 days after radiation in all cases. No relation was noted between its occurrence and diet or fasting. Serum obtained either with or without fasting (20 hr) was always clear except for the opalescence following radiation. On the other hand, opalescence has been found in both fasting and nonfasting animals after radiation.

In the present series of rabbits, there is no relation between opalescence and changes in weight, white cell count, lymphocyte, or heterophile count 24 hr after radiation. The absence of any red pigmentation in opalescent serum tends to rule out erythrocyte hemolysis as a causative factor. Also, there seems to be no direct relation between opalescence and radiation dose rate. Table 1 lists data pertinent to this report. Detailed coagulation and hematological studies on these animals will be reported subsequently.

Studies are in progress with the collaboration of Dr. John Gofman to determine the chemical nature of opalescence. The opalescence can be eliminated from serum by acetone and ether extraction according to the method described by Blix (*1*). In low speed ultracentrifugation, material that is responsible at least in part for the opalescence rises to the top, to leave a clear infranatant solution.

At present, there is no clear explanation of the mechanism by which radiation produces this opalescence. In view of its apparent relation to death, the phenomenon may not only provide a valuable early measurement of the effect of acute exposure to radiation, but may lead to further knowledge concerning the nature of radiation sickness and its lethal mechanisms.

TABLE 1

DOSAGE OF TOTAL BODY IRRADIATION, APPEARANCE OF SERUM OPALESCENCE, SURVIVAL TIME, LYMPHOCYTE, AND HETEROPHILE COUNTS IN RABBITS

Rabbit No.	Radiation dose	Dose rate	Opalescence* of serum 24 hr after radiation	Days of survival after radiation			Lymphocyte count		Heterophile count	
				Died from radiation	Died other causes	Sacrificed	Before radiation	24 hr after radiation	Before radiation	24 hr after radiation
	r	r/min								
2	200	25.8	None	..	..	28†	4700	1960	4610	2640
1	400	25.8	None	..	..	28†	5560	1030	2570	3180
1	400	23.2	None	..	..	34	2060	840	3230	5810
2	400	23.2	None	..	..	34	1920	990	2880	5346
3	800	47	None	..	..	32	8360	240	2640	7520
7	800	24	Marked	5	..	..	9510	1020	5430	7310
8	800	52	Marked	2	..	..	6980	660	1870	10120
10	800	52	Slight	..	16‡	..	6770	520	1850	9460
11	800	52	Slight	..	..	31	8450	970	1180	9400
12	800	54	None	..	9§	..	2840	150	2440	4980
13	800	54	None	..	..	31	5100	470	2100	3430
5	1000	24	Marked	5	..	..	5740	250	7760	8050
9	1000	52	None	..	..	30	4710	580	6330	6570
14	1000	43.5	None	..	10‖	..	4820	330	2190	3690
15	1000	43.5	Marked	31 hr	..	..	8500	4520	1360	2810
16	1000	44	Moderate	..	..	35	11400	310	2810	7330
17	1000	44	.....	20 hr	..	..	6530	....	2400	.....

* Serum was never opalescent except in the period 24 hr after radiation.

† Not sacrificed; 400 r given on 28th day after first radiation.

‡ Died 20 min after Nembutal. Post-mortem: small right hemothorax; otherwise negative on gross examination.

§ Died within 1 hr after Nembutal and cardiac puncture. Post-mortem: marked gastric dilation with moderate pyloric hypertrophy; otherwise negative on gross examination.

‖ Died ½ hr after cardiac puncture; marked hemopericardium present; post-mortem otherwise negative; gross examination.

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