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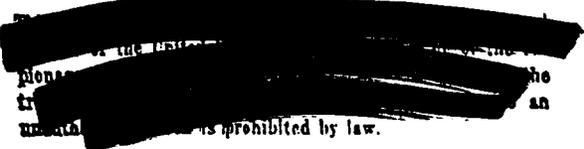
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February 2, 1953

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FROM: W. C. Hanson, R. L. Browning and W. H. Braymen, Biology Section

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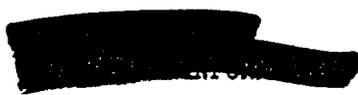
WATERFOWL CONTAMINATION OBSERVED AT REDOX SWAMP DURING DECEMBER, 1952

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INTRODUCTION

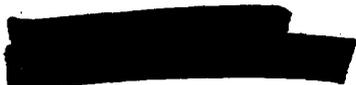
On December 1, 1952, the Biology Section was advised of extensive radioactive contamination in the pond created by waste water from 202-S (Redox) operations. Since the water was being utilized by significant numbers of migrant waterfowl, the existence of health hazards to consumers of the birds was investigated, results of which are presented herein.



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METHODS

Wild waterfowl were collected December 3 and 4 from two waste water ponds designated Redox swamp and "U" swamp. Formation of Redox swamp began during January, 1952, upon start-up of the 202-S facility and at present the water covers approximately eight acres to depths ranging from two feet at center to less than one foot at the perimeter. Vegetation at the site represents the initial stage of radical transformation from a xeric to hygric situation and as such appeals to waterfowl mainly as a resting location. At the time of collection approximately 1500 puddle ducks (mallards, pintails, teal, etc) and 14 Canada geese were observed utilizing the pond for varying periods of time, shuttling between Redox and "U" swamps in response to human activity in the vicinity.

Three general degrees of exposure to the Redox contamination were represented by waterfowl collected: (1) chronic, by an injured pintail duck confined to Redox swamp; (2) periodic, by Canada geese which utilized that location approximately fifty per cent of the time; and (3) recurrent, by puddle ducks which visited the Redox pond for short periods only. A fourth group, those utilizing only "U" swamp, is represented by American coots.

All specimens were monitored by portable survey instruments immediately after taking. Samples of various tissues, organs and feces were then removed, weighed, macerated on 1 1/2" stainless steel plates in the presence of 0.5 N NaOH, dried under an infra-red lamp and counted with a mica-window BGO counter to determine total beta activity. Additional samples of bone, muscle, liver and feces were processed by chemical separation to determine amounts of ruthenium¹⁰³, ruthenium¹⁰⁶ and plutonium²³⁹ in relation to other beta or alpha emitters, the latter derived by ether extraction and TTA procedures. Ruthenium determinations presented



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several difficulties due to volatility of the isotopes and inefficiency of present methods of counting, requiring the application of several correction factors. Ruthenium analyses upon which data of this report are based were resolved to the distillation of Ru by perchloric acid, trapping the distillate in NaOH solution, heating the trap solution in the presence of ethyl alcohol until the RuO₂ was coagulated, then centrifuged, plated and counted initially on the second shelf of a BCO counter with no absorber and then repeated with 350 mg/cm² Al absorber inserted on the first shelf. Recovery by this process is estimated at 40 to 60% quantitative yield.

Calculation of tissue activity densities to a microcuries per gram basis for Ru¹⁰³ and Ru¹⁰⁶ are based upon the assumption that only these elements were separated in processing and the remaining activity of other fractions was due to several other fission products. The values assigned various samples are, therefore, to be considered as an approximation only.

RESULTS AND DISCUSSION

Portable instrument reading of 250 mrep/hr on the ventral body and wing surfaces and 75 mrep/hr over the dorsal body surface were obtained from the duck chronically exposed. Five geese, periodically-exposed specimens, delivered a dosage rate of 100 mrep/hr at one-foot distance. Puddle ducks presented external readings of less than 100 c/m.

Radioassay of the waterfowl proved the chronically and periodically exposed specimens worthy of concern as health hazards, as evidenced by the tissue activity densities tabulated on the following page:

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Specimen	Total Beta Activity Density in d/m/g			
	Feces	Bone	Liver	Muscle
Pintail	5,000,000	57,900	42,000	17,200
Goose #1	32,000	4,000	800	700
Goose #2	31,600	1,800	700	200
Goose #3	23,900	4,200	500	300
Goose #4	32,400	3,000	900	200
Goose #5	54,700	4,700	100	200
Mallard #1	80	310	110	130
Mallard #2	130	150	80	30
Mallard #3	100	70	80	60
Coot #1	220	140	230	130
Coot #2	230	600	240	140

Tissues of primary interest are liver and muscle, since they are the edible portions of the birds. Feces and bone are included to illustrate the metabolic nature of the fission products and their contribution to whole body irradiation. Ruthenium analysis indicated the following approximate percentages of the total beta count due to Ru-98: liver 17%, muscle 3%, feces 1%, and bone 0.1%. Resolved to activity densities on a per gram basis, these values are as follows:

	$\mu\text{c/g} \times 10^3$	
	<u>Ru 103</u>	<u>Ru 106</u>
Feces	40.6	3.4
Liver*	3.4	0.4
Muscle*	0.6	0.05
Bone	Negligible	

*Dosage rates to liver and muscle by ruthenium isotopes are approximately 0.5 and 0.01 rep/day respectively.

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Some indication of fission products contributing a majority of the activity in various fractions are contained in the following absorption and decay curve data:

Sample	Beta Particle Energies	Half-lives
Feces	45% below 0.3 mev Remainder similar to Ru ¹⁰⁶ Rh ¹⁰⁶ , maximum of 2.45 mev	> 90 days
Muscle	All below 0.75 mev	Long-lived
Bone	All below 1.25 mev	20% ~ 10 days 80% long-lived
Liver	30% below 0.6 mev Remainder to a maximum of 1.8 mev	20% ~ 10 days 80% ~ 105 days

Positive alpha contamination was found in relatively unimportant amounts, a maximum value of 480 d/m total alpha/g being noted in the feces of the pintail duck. TTA analysis established Pu²³⁹ the contributor of ninety per cent of this amount. Goose feces densities ranged from 4 to 10 d/m total alpha/g. No external alpha contamination was observed.

PROGNOSIS

Plant succession, the normal progression of vegetation from flora of low rank to perennial plants and shrubs of higher phylogeny, can be expected in the near future to transform the Redox swamp from a mere pool of water on sagebrush flatland into desirable waterfowl habitat. Excellent examples of this phenomenon



are other waste water impoundments such as "U" and "T" swamps in 200 West Area. Upon the assumption of such development by Redox swamp, the various audio and visual methods of frightening waterfowl which were employed at that location during December and January can be expected to have a limited effect. Not only can large populations of migrating waterfowl then be expected to utilize the location for longer periods of time, but limited numbers of resident birds will produce young on these waters which will assimilate greater amounts of contamination due to their natural requirements. Weighting these facts further is the probable uptake and concentration of radioisotopes by waterfowl food plants in the water and a progressive increase of contamination into the pond. Portable instrument surveys on January 12 indicated values up to 3 rep/hour at water surface of the pond inlet.

Public relations consideration emphasizes the need for corrective measures to prevent recurrence of extensive waterfowl contamination at Redox swamp, since adverse publicity and public concern were expressed during the remainder of the 1952 waterfowl hunting season following unauthorized rumors pertaining to radioactive contamination of waterfowl on the Hanford Works. Suggested means by which similar situations may be avoided include impounding the water within definite limits and covering with mesh wire, underground storage of the waste water or effective vegetation control with sufficient devices for frightening waterfowl away. The latter should be considered only if other methods are found more impractical.

SUMMARY

Waterfowl chronically and periodically exposed to Redox swamp contamination contained sufficient amounts of beta radioactivity to deliver whole-body

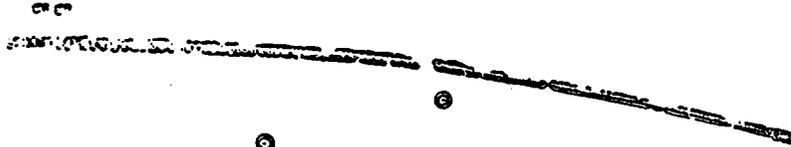
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irradiation rates of 100 to 250 mrep/hour. Total beta activity densities of 17,000 to 42,000 d/m/g tissue were observed in edible portions of chronically-exposed birds. Plant succession and increments of contamination portend a more serious situation in the future unless corrective measures are instituted.



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