the direct reaction of perchloromethyl mercaptan with morpholine. An excess of morpholine is employed in this synthesis to tie up the HCl formed in the reaction. *N*-trichloromethylthio-morpholine is a white crystalline material melting at 86°–87° C.

Sixteen compounds which were condensed with perchloromethyl mercaptan are listed in Table 1, along with the empirical formulas and melting points of the new organic compounds produced by the resultant reactions. Biological assays have shown that all the compounds exhibited an LD_{50} value of less than 10 ppm against the fungi *Alternaria solani* and *Sclerotinia fructicola* by the slide germination technique (*6*).[1]

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[1] The laboratory fungicide tests were carried out in the Standard Oil Development Company's cooperative project at Rutgers University under the supervision of R. H. Daines and Lyle E. Hagmann.

Pre-Cambrian Uraninite, Sunshine Mine, Idaho

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Uranium ore was first discovered in the Sunshine Mine, Coeur d'Alene district, Kellogg, Idaho, in the summer of 1949. Uraninite was subsequently identified as the responsible mineral and occurs in the vicinity of the Sunshine vein at various places from the 2900′ level to the lowest level at 3700′.

The mineral is found in veins somewhat comparable to the nonpegmatitic occurrences of the northwestern Canadian Shield. These veins are cut in a number of places by later siderite veins carrying silver-bearing tetrahedrite. The wall rock belongs to the St. Regis formation (pre-Cambrian quartzite).

Through the geological studies of Ransome and Calkins (*1*), Shenon and McConnel (*2*), and others, the general relationships of the silver veins are well known. The opinion has prevailed (*3*) that the mineral deposits of the Coeur d'Alene are associated with Mesozoic or later igneous activity. Recent reference to the uranium occurrence (*4*) places the uraninite after tetrahedrite, the common silver ore mineral.

Specimens of uranium ores supplied by R. H. Robinson, chief geologist of the Sunshine Mine, studied in the Mineralogical Laboratory of Columbia University, indicate an origin for the uraninite earlier than the tetrahedrite. Laboratory criteria are inadequate to demonstrate, however, whether the uranium was introduced merely at the beginning of the silver-precipitating epoch or during a distinctly earlier mineralization. Arrangements were made, therefore, to secure data for an age determination.

Through the cooperation of the Division of Raw Materials, AEC, both chemical analyses and lead isotope analyses have been secured. The material selected for analysis was collected on the west face of No. 16 stope in the footwall of the Sunshine vein, west of the Jewell crosscut and above the 3100′ level. Uraninite occurs in small veins and segments of veins associated with an alteration halo of fine-grained pyrite and red jasper. Small fragments were broken from vein specimens and examined microscopically for purity. Uraninite was identified by x-ray diffraction, the lattice constant being 5.4439. A chemical analysis of Sunshine uraninite with uraninite analyses from two other localities by Clara Gale Goldbeck, chief, Microchemical Branch, New Brunswick Laboratory, AEC, is given in Table 1. Isotope analyses by Roger Hibbs, chief, Mass Assay Laboratory, Carbide and Carbon Chemicals Company, Oak Ridge, are also included.

On the basis of the analyses, computations have been made by Kulp as given in Table 2 using 4.50×10^9 yr for the half-life of U^{238} and 7.07×10^8 yr for the half-life of U^{235}. Although the half-life of U^{235} has been a subject of debate during the past few years, the value of 7.07×10^8 accepted at present is essentially that proposed by Nier a decade ago.

An uncorrected age from $\left(\frac{Pb}{U + Th}\right)$ of 1050 ± 50 M.Y. is obtained from the graph published by Wick-

TABLE 1

CHEMICAL ANALYSES

	Sunshine	Martin Lake	Caribou
U_3O_8	26.9	67.5	40.77
Th and R.E.	—	—	1.7 (No Th)
SiO_2	18.2	0.42	
PbO	4.0	7.96	4.15
Al_2O_3	4.4		
Fe_2O_3	—	0.94	
Fe	13.1	—	3.15
CaO	.8	12.7	
MnO	—	0.85	
Mn	1.0		
CuO	—	—	0.55
Cu	7.7	—	
Ag	1.0		
Sb	2.6		
H_2O	1.1	0.62	5.3
CO_2	6.8	4.68	0.22
S	9.	0.01	8.3
V_2O_5		0.3	
NiO			0.34
ZnO			1.22
	Lead Isotopes		
208	17.84 ± 0.07	0.460 ± 0.013	50.67 ± 0.05
207	12.42 ± 0.05	7.32 ± 0.02	20.69 ± 0.03
206	69.20 ± 0.03	92.17 ± 0.01	27.27 ± 0.05
204	0.540 ± 0.010	0.044 ± 0.001	1.37 ± 0.02

TABLE 2

AGE CALCULATION

	Sunshine Mine specimen			
	204	206	207	208
Isotopes present	0.540 ± .01	69.20 ± .03	12.42 ± 0.05	17.84 ± 0.07
Assume for common lead	1.000	16.00 ± 1.0	15.35 ± 0.2	35.4 ± 1.0
∴ Original common lead	0.540	8.65 ± 0.50	8.29 ± 0.30	19.1 ± 1.0
∴ Radiogenic lead	—	60.55 ± 0.50	4.13 ± 0.4	Nil

$\therefore gPb^{206}/100g = 2.26 \pm 0.02$; $gPb^{207}/100g = 0.154 \pm .002$

$Pb^{207}/Pb^{206} = 6.8\% \pm 0.2$, $\therefore t = 850 \pm 50$ million years

Pb^{206}/U^{238}, $t = 1.501 \times 10^{10} \log \left(1 + \frac{1.15\ Pb^{206}}{U^{238}}\right) = 710 \pm 10$ M.Y.

Pb^{207}/U^{235}, $t = 2.37 \times 10^{9} \log \left(1 + \frac{158\ Pb^{207}}{U^{238}}\right) = 750 \pm 10$ M.Y.

man (*5*). The Pb^{206}/U^{238} age of 710 ± 10 M.Y. results from the equations derived by Keevil (*6*). On the same basis the Pb^{207}/U^{238} age is 750 ± 10 M.Y. The graphical solution given by Nier (*7*) was used for Pb^{207}/Pb^{206} and gives 850 ± 50 M.Y. If the radon loss is assumed to be the major source of divergence in the age ratios, and the Pb^{206}/U^{238} age is adjusted to equal the Pb^{207}/U^{235} age, it turns out that the Pb^{207}/Pb^{206} age also becomes 750 ± 50 M.Y. The unweathered condition of the material, the particle size, and the distribution of the uraninite make the assumption of radon loss as the main source of error quite reasonable.

The computed age of 750 M.Y. indicates that the Sunshine uraninite is much older than Mesozoic—i.e., is late pre-Cambrian. Since the fractures in which the Sunshine vein occurs cut the north limb of the Big Creek anticline (*2*) in which the Beltian sediments are folded, it is logical to assume that the original deformation must have been even earlier pre-Cambrian.

In order to confirm the determination on the basis of geological occurrence, data are included on uraninite from two other localities with considerably different age relationships. One locality is the Caribou Mine, near Nederland, Colo. (presumably Tertiary); the other, Martin Lake, near Beaverlodge, north of Lake Athabasca, Canada (presumably pre-Cambrian).

The computations on uraninite from these two localities are given in Tables 3 and 4.

The age of 890 M.Y. for Martin Lake is in reasonable agreement with other values on record for the general pre-Cambrian area. The Caribou data, however, strongly suggest that the uraninite is Tertiary.

In view of the variance of the Sunshine age determination from previous geological interpretations, additional study is being undertaken both to verify the current report and to further clarify the geological interpretation.

TABLE 4

AGE CALCULATION

	Caribou specimen			
	204	206	207	208
Observed	1.37 ± .02	27.27 ± 0.05	20.69 ± 0.03	50.67 ± 0.05
	1.000	18.00 ± 1.	15.5 ± 0.2	38.0 ± 1.0
	1.37	24.6 ± 1.3	21.2 ± 0.2	52.0 ± 1.5
	—	2.7 ± 1.4	Nil	Nil

$gPb^{206} = 0.105$

$Pb^{206}/U^{238} \longrightarrow 23 \pm 10$ M.Y.

(The large amount of common lead invalidates the uncorrected age.)

TABLE 3

AGE CALCULATION*

	Martin Lake specimen			
Lead isotopes	204	206	207	208
Observed	0.044 ± .001	92.17 ± 0.01	7.32 ± 0.02	0.460 ± 0.013
Assumed common Pb	1.000	16.00 ± 1.0	15.35 ± 0.01	35.4 ± 1.0
Original common Pb	0.044	0.70 ± 0.04	0.68 ± 0.004	1.56 ± .04
	—	91.47 ± .05	6.64 ± 0.02	(−1.10?)

Uncorrected age $\left(\frac{Pb}{U + Th}\right) \longrightarrow 870$ M.Y.

$gPb^{206} = 6.82 \pm 0.06$; $gPb^{207} = 0.495$

$Pb^{207}/Pb^{206} = 7.25\% \longrightarrow 900 \pm 10$ M.Y.

Pb^{206}/U^{238} $t = 860 \pm 5$ M.Y.

Pb^{207}/U^{235} $t = 980 \pm 5$ M.Y.

* If 890 is assumed as the true age and correction made for radon loss, as discussed above, then 206/238 becomes 890 M.Y., and the 207/206 ratio again is brought into agreement, becoming 890 ± 10 M.Y. The "uncorrected age" in this case is close to the true age simply because of the low concentration of common lead.

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The Natural Resistance of the Golden Hamster to Colchicine

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In the course of an investigation of the origin of tertiary giant cells in the pregnant uterus of the hamster, *Cricetus auratus,* it was decided to use colchicine to study proliferative growth. Doses varying from .1 mg up to 2 mg/100 g of body weight were injected, and the animals were killed 6–21 hr thereafter. No significant variation from the normal number of mitoses was observed, and the presence of anaphase and telophase stages with normal spindles in normal ratio suggested that these doses were ineffective. A review of the literature indicated that the effective dose in other rodents, mice, rats, and guinea pigs, and in rabbits, is usually just below the lethal level. In an attempt to establish the effective dose, and to test the potency of the colchicine used, a series of hamsters, mice, rats, and one rabbit were injected intraperitoneally from the same solution of colchicine, injections varying in concentration from 0.12 to 7.0 mg/100 g of body weight. Young mature males were used for this entire series. Time of injection, concentration, and subsequent history were recorded, the animals being checked in the morning, during the day, and in the evening. The results are recorded in Table 1.

Both rats and mice, and also the rabbit killed in this study by the lethal effects of colchicine displayed the classical symptoms of colchicine poisoning: diarrhea, bloody stools, lethargy, and progressive paralysis appearing first at the caudal end and extending cephalad. Several of the rats displayed bloody nasal hemorrhages.

The hamsters showed no effects whatever. All animals that were tested proved fertile. No attempt was made to check against the possibility of a certain post-treatment period of infertility, but some animals were tested and proved fertile as early as 5 days and others as late as 37 days after treatment, and hence there is no reason to believe that any infertile period occurs.

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Moreover, there was a normal increase in weight of 1.5–15 g/animal from the time of injection to the termination of the experiment, 4–8 weeks later.

Another series of 6 male animals (2 rats, 2 hamsters, and 2 white mice) was fed a mixture of one third *Colchicum autumnale* seed,[2] containing not less than 4.5 mg colchicine/g of seed, mixed with two thirds pulverized Purina laboratory chow blocks, in order to determine if the seed, too, affects rats and mice and not hamsters. Five g of this was fed daily to each rat, 3 g daily to each hamster, and 2 g daily to each mouse. From the third day the amount of food for each animal was doubled in order to ensure an adequate nutritive supply. The animals were kept in individual cages with water dishes; one of each pair had shavings for bedding; the other cage was left bare. The food was placed on a paper on the floor of the cage.

TABLE 1

APPROXIMATE LENGTH OF SURVIVAL FOLLOWING VARYING DOSES OF COLCHICINE

Dosage (mg)	Mouse	Rabbit	Rat	Hamster
.12			Lives	Lives
.25			2 days, 14 hr	"
.50	5 days		24 hr	"
1.0	3 days, 21 hr	8 hr	21 "	"
1.5	24 hr		10 "	"
2	24 "		4–4.5 "	"
3	10 "			"
4	10 "			"
5–10				"

Both mice died on the 7th day of the experiment. One had dropped in weight from 24 to 20 g; the mouse with no bedding dropped from 24 to 15.6 g.

The rat in the bare cage had dropped from 112 g to 69.2 g by the 6th day, when it died. The other rat had dropped in weight from 99 to 68.3 g by the 9th day, when it was sacrificed. Diarrhea could of course account for part of the weight loss, but the second rat seemed to be starving voluntarily. Large amounts of uneaten food were present in both the rat cages.

The two hamsters gained 1.5 g and .6 g during the same period.

A control mouse, fed identical gram amounts of pure chow alone, rose in weight from 25.5 to 25.7 g at the end of 9 days.

The injection series definitely indicates that the hamster possesses a natural resistance to the usual toxic effects of colchicine, a resistance which far exceeds that of other laboratory animals. Poe and Johnson (*1*) report the lethal dose of colchicine in the rat to be 1 mg/kg body weight injected intraperitoneally, with death in 51 hr. Sollmann and Hanzlik (*2*) give 1 mg/kg body weight injected intramuscularly as the lethal dose for the dog and cat. The lethal dose in man is said to be variable, but is about 8 mg/kg body weight (*3, 4*).

[2] Supplied through the courtesy of S. B. Penick & Co.